SPRING 1990 NONDESTRUCTIVE EXAMINATIONS OF SELECTED CLASS 1 AND CLASS 2 COMPONENTS OF THE SALEM GENERATING STATION, UNIT 2

VOLUME I
FINAL REPORT
WITH APPENDICES
SwRI Project 3373

Prepared for

Public Service Electric and Gas Company
Nuclear Division
P.O. Box 236
Hancocks Bridge, New Jersey 08038

July 1990

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NONDESTRUCTIVE EVALUATION SCIENCE
AND TECHNOLOGY DIVISION

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July 26, 1990
Doc. No. 17-3373(16)

Mr. Robert Brandt
Public Service Electric and Gas Company
Nuclear Division
P. O. Box 236
Hancocks Bridge, New Jersey 08038

Subject: Southwest Research Institute Final Report 3373: "Spring 1990 Nondestructive Examinations of Selected Class 1 and Class 2 Components of the Salem Generating Station, Unit 2"

Dear Mr. Brandt:

Enclosed is one copy of Southwest Research Institute Final Report 3373: "Spring 1990 Nondestructive Examinations of Selected Class 1 and Class 2 Components of the Salem Generating Station, Unit 2." This report is presented in three volumes: Volume I contains the report text, inservice examination (ISI) summary tables, and appendices; Volumes II and III contain the field data. Two copies of the report have been sent to Mr. C. J. Conner.

It has been a pleasure providing ISI services for Public Service Electric and Gas Company during this outage, and we look forward to working with you in the future. If you should have additional questions or comments regarding this report, please contact me at your earliest convenience.

Sincerely,

John R. Ingamells
John R. Ingamells
Project Manager
Engineering and Analysis Section
Department of NDE Services

mlb

Enclosures

cc: Mr. C. J. Conner, w/Encl.

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Written by

John R. Ingamells
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Approved by

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Director
Department of NDE Services
Nondestructive Evaluation Science
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ABSTRACT

An inservice examination (ISI) of selected Class 1 and Class 2 components of Public Service Electric and Gas Company's (PSE&G) Salem Generating Station, Unit 2, was performed by Southwest Research Institute (SwRI) personnel during the April-May 1990 refueling outage. These examinations constituted the fifth ISI performed at Salem Unit 2 during the first 10-year interval of operation. After the onsite portion of the ISI, a special examination of Reactor Coolant Pump (RCP) flywheel No. 22 was performed at the Westinghouse, Cheswick, Pennsylvania, facility.

The ISI was performed utilizing visual (VT), magnetic particle (MT), liquid penetrant (PT), and manual ultrasonic (UT) nondestructive examination techniques.

UT thickness measurements were taken on selected piping using the SwRI Thickness Data Acquisition System. At PSE&G's request, the results of the thickness examinations were reported during performance of the examinations, and a separate summary report was prepared.

During the remote VT examination of the reactor pressure vessel with the core barrel in place, numerous linear and irregular indications were revealed in the core barrel and reported on Customer Notification Form (CNF) 90-1. An attempt to interrogate the most significant indication with UT yielded inconclusive results. Fracture mechanics analysis was performed by PSE&G assuming the worst case (through-wall) and the core barrel will be allowed to operate through another refueling cycle when the areas will again be examined.

Limitations which differed from those recorded during the preservice examination were noted on CNF 90-2 for the purpose of inclusion in the Long-Term Plan and limitations relief request.

The UT examination of bolting on valve 24-MS-167 revealed heavy deposits of yellow plastic-like substance on the valve body, and this condition was reported on CNF 90-3.

The PT portion of the examination of RCP flywheel No. 22 revealed 21 tool chatter indications in the three keyways, and these were reported on CNF SAM2-FW-001. The indications were accepted "as is" for continued use.

No other reportable indications were observed during this ISI.

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FIGURE

LIST OF ABBREVIATIONS

ASME	-	American Society of Mechanical Engineers
BF	-	Feedwater System
B&PV	-	Boiler and Pressure Vessel
CNF	-	Customer Notification Form
CV	-	Chemical Volume Control System
CVCT	-	Chemical Volume Control Tank
ELHEX	-	Excess Letdown Heat Exchanger
FLW	-	Flywheel
ISI	-	Inservice Examination
LTP	-	Long-Term Plan
MS	-	Main Steam
MT	-	Magnetic Particle Examination
NDE	-	Nondestructive Examination
NPOP	-	Nuclear Projects Operating Procedure
NQAPM	-	Nuclear Quality Assurance Program Manual
NRC	-	Nuclear Regulatory Commission
PMP	-	Reactor Coolant Pump
PR	-	Pressure Relief System
PSE&G	-	Public Service Electric and Gas Company
PT	-	Liquid Penetrant Examination
PZR	-	Pressurizer
QA	-	Quality Assurance
RC	-	Reactor Coolant System
RCF	-	Reactor Coolant Filter
RH	-	Residual Heat Removal System
RPV	-	Reactor Pressure Vessel
SJ	-	Safety Injection System
STG	-	Steam Generator
SwRI	-	Southwest Research Institute
TDAS	-	Thickness Data Acquisition System
UT	-	Manual Ultrasonic Examination
VT	-	Visual Examination

I. INTRODUCTION

During the spring 1990 refueling outage, Southwest Research Institute (SwRI) personnel performed nondestructive examinations (NDE) of selected Class 1 and Class 2 components of the Salem Generating Station, Unit 2. These examinations constituted the fifth inservice examination (ISI) of the first inspection interval of commercial operation.

A. Applicable Documents

The ISI was conducted in accordance with the following documents:

- Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1974 Edition with Addenda through Summer 1975 (74/S75)
- Long-Term Inservice Inspection Plan for Class 1 and Class 2 Components and Systems for Salem Generating Station, Unit 2, Revision dated March 1989
- SwRI Final Plan 17-3373, "Examination Plan for the 1990 Inservice Examination of Salem Generating Station, Unit 2," with changes made on site and approved by Public Service Electric and Gas Company (PSE&G) personnel
- SwRI Nuclear Quality Assurance Program Manual (NQAPM), Rev. 3, with all applicable changes

B. Examination Areas

Selected welds and components in the following Class 1 and Class 2 areas were examined by SwRI personnel utilizing NDE techniques:

Class 1

Vessels

Reactor Pressure Vessel
Pressurizer
Steam Generators 21 and 24

Piping

Chemical Volume Control System
Pressurizer Relief System
Pressurizing System
Reactor Coolant System
Residual Heat Removal System
Safety Injection System

Pumps

Reactor Coolant Pump Bolting, 21 and 24 RCP
Reactor Coolant Pump Casing, 21 RCP
Reactor Coolant Pump Flywheels 12, 22, and 23

Class 2

Vessels

Steam Generator 23
Reactor Coolant Filter

Piping

Main Steam System
Residual Heat Removal System

Valves

Main Steam

II. DISCUSSION OF EXAMINATION ACTIVITIES

A. Pre-Outage Planning

In order to assure efficient performance of the ISI, SwRI devoted a concentrated effort toward planning and preparation for the examination activities. This included review of the Long-Term Plan (LTP) and extracting from it all examinations scheduled for the remainder of the first 10-year interval. PSE&G personnel reviewed the total requirement and from this listing selected examination areas that would best complement the other activities planned during the outage. Nuclear projects operating procedures (NPOPs) were developed to conform to Revision 3 of the SwRI NQAPM and submitted to PSE&G for approval. These activities were accomplished by SwRI's Engineering and Analysis Section with assistance provided by the NDE Field Applications Section and culminated in the development of an Examination Plan.

The Examination Plan was developed to provide the basis for the ISI in one comprehensive document. It provided a listing of the examination areas, copies of all procedures, calibration block drawings, weld identification figures, and other information pertinent to the performance of the ISI. In addition to the Class 1 and Class 2 components selected for examination, other components were scheduled for examination at the request of PSE&G. The Examination Plan was reviewed and approved by PSE&G prior to SwRI's arrival on site.

B. Examination Procedures and Personnel

The NDE activities were performed using visual (VT), liquid penetrant (PT), magnetic particle (MT), and manual ultrasonic (UT) techniques. These examinations were performed by SwRI and SwRI-contracted personnel in accordance with SwRI procedures which had been pre-approved by PSE&G personnel.

The SwRI NPOPs were written to conform to the requirements of the applicable sections of the ASME B&PV Code, SwRI's NQAPM and the specific requirements of Salem Unit 2. Copies of these procedures are in Appendix C.

SwRI examination personnel were certified in accordance with SwRI NPOP 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification," which incorporates the guidelines of SNT-TC-1A of the American Society for Nondestructive Testing and ASME Section XI. SwRI-contracted examiners were similarly certified. A copy of each examiner's certifications is included in Appendix E.

C. Examination Activities

This section provides a discussion of the various NDE activities performed during the ISI. SwRI examination data records are included in Volumes II and III. A discussion of equipment and materials used for these examinations appears in Subsections F and G of this section of the report.

1. VT Examinations

VT examinations were performed on the reactor pressure vessel (RPV) exposed with the core barrel in place and the upper internals and fuel removed. VT examinations were also performed on main steam valve bolting.

2. *PT Examinations*

Solvent removable, and water washable visible dye penetrant examinations were performed by SwRI personnel on selected Class 1 and Class 2 piping, pump casing, and support welds.

3. *MT Examinations*

Examination personnel used an AC yoke and dry particle MT to examine main steam replacement piping welds to establish a baseline for future examinations.

4. *UT Examinations*

UT examinations were performed on Class 1 and Class 2 components, including vessels, studs, austenitic piping, ferritic piping, and dissimilar metal welds. Various techniques were used to perform the UT examinations, depending on material type and weld thickness. For typical vessel and piping examinations, the following techniques were used:

a. A 0-degree lamination scan (UT0L) was used for detection of laminar reflectors which might affect interpretation of angle-beam results.

b. A 0-degree scan (UT0W) was used for detection of reflectors in the weld when limitations restricted angle-beam examinations.

c. For austenitic and ferritic welds, angle-beam scans of 45 and 60 degrees (UT45 and UT60) were used for detection of reflectors oriented parallel to the weld.

d. Angle-beam scans, using 45-degree search units directed parallel to the weld (UT45T) were used on piping for detection of reflectors oriented transverse to the weld. For vessel examinations, 45- and 60-degree scans parallel to the weld were performed for detection of transverse reflectors.

5. *TDAS Examinations*

Thickness measurements using SwRI's Thickness Data Acquisition System (TDAS) were recorded at 73 locations to identify possible pipe erosion/corrosion. Results of the TDAS examinations in the form of quantitative numeric plots of the fittings were reported to PSE&G personnel during the examinations, and a separate summary report was submitted.

6. *Special Examinations*

At the request of PSE&G, a special series of examinations were performed in response to NRC Bulletin No. 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems," sixteen 1.5-inch Safety Injection, two 2-inch, two 3-inch Chemical Volume and Control welds, and all four welds on the pressurizer surge line were examined with UT and PT for the second consecutive refueling outage.

After the onsite portion of the ISI, an examiantion of RCP flywheel No. 22, removed from the pump, was performed at the Cheswick, Pennsylvania, Westinghouse facility.

D. Examination Results

During the remote VT examination of the RPV with the core barrel in place, numerous linear and irregular indications were revealed and reported on Customer Notification Form (CNF) 90-1.

An attempt to interrogate the most significant indication with UT yielded inconclusive results. Fracture mechanics analysis was performed by PSE&G assuming the worst case (through-wall) and the core barrel will be allowed to operate through another refueling cycle and the areas will again be examined.

The UT examination of bolting on valve 24-MS-167 revealed heavy deposits of yellow plastic-like substance on the valve body which was reported on CNF 90-3.

Limitations which differed from those recorded during the preservice examination were noted on CNF 90-2 for the purpose of inclusion in the Long-Term Plan and limitations relief request.

Copies of the CNFs are included in Appendix G.

No other reportable indications were observed during this ISI.

E. Quality Assurance Surveillance

A representative from the SwRI Quality Assurance (QA) Section was on site for approximately 25 percent of the onsite activities to perform the appropriate surveillance duties. In addition to those duties, the QA representative reviewed approximately 30 percent of the ISI data generated by SwRI. A complete copy of the SwRI QA Audit Report was provided to PSE&G under separate cover.

F. Equipment

Various NDE equipment was used during the ISI to perform the examinations of the selected components. Major equipment is discussed below.

1. *Sonic FTS Mark I*

Sonic FTS Mark I ultrasonic instruments were used for the UT examinations and thickness gauging of materials.

To assure proper instrument linearity and operation, SwRI certified each Sonic FTS Mark I prior to use at Salem Unit 2, in accordance with SwRI NPOP 12.0-NDES-107, "Alignment of Sonic Model FTS Mark I Flaw Detector." Copies of certifications for those instruments utilized at Salem Unit 2 are contained in Appendix F. Additionally, instrument linearity was checked and documented on site as required by individual NPOPs.

2. *Transducers*

Various brands, sizes, and frequencies of ultrasonic transducers were used to perform the examinations. A transducer frequency of 1.5, 2.25, or 5.0 MHz was used as specified in the applicable NPOP.

Prior to use at Salem Unit 2, each transducer was given a frequency profile and beam spectrum analysis and certified to be within SwRI's acceptance standards. This analysis is performed within 12 months of use to verify that each transducer is performing within standards. A copy of each transducer's certification is contained in Appendix F.

Information on the actual transducer used for any specific examination may be determined by reviewing the data sheets and referenced calibration sheets in the field data volumes.

3. *MT Examination Equipment*

Hand-held alternating current magnetic particle yokes were used for MT examinations.

G. Materials

In addition to the equipment previously discussed, certain materials were required to conduct the examinations. All materials contacting the examination surface (i.e., glycerine, pipe marking pencils, penetrants, etc.) were tested and certified to be within acceptable sulfur and halogen limits prior to use at Salem Unit 2. Certifications for these materials are contained in Appendix F.

H. UT Calibration Blocks

Pipe and vessel calibration blocks were utilized to calibrate the UT instruments prior to examination of the selected welds. Drawings of the various calibration blocks used are contained in Appendix D

III. SUMMARY OF EXAMINATIONS

This section provides a discussion of the field data records and a summary of the NDE activities performed at Salem Unit 2.

A. Explanation of Field Data Records

The results of the examinations and calibrations performed by SwRI personnel were recorded on standard SwRI forms. Copies of these completed documents constitute Volumes II and III of this report. The original records will be retained in the SwRI Data Storage Facility.

The field data records for each weld or area are assembled in a package preceded by a summary sheet. The examination areas and summary sheet numbers correspond to those listed in the Summary Table (Pages 9-34). A general explanation of the individual field data forms follows.

The instruments used in performing UT examinations were calibrated prior to use, then verified again at specified intervals during the examinations and upon completion of the examinations. The calibration parameters were recorded on the appropriate calibration record sheet as specified in the applicable NPOP. The documented calibration and calibration verification provide immediate assurance that the examinations were performed using properly calibrated instruments.

The results of the examinations were recorded on the applicable data record sheets as specified in the Examination Plan. The information documented on these forms describes the parameters associated with those indications which were greater than the recording levels specified in the applicable NPOPs.

The size, location, and nature of reflectors were determined by analyzing the indication parameters recorded on the forms described above. The analysis is documented on SwRI Indication Resolution Record Sheets, which are included as part of each data package, when required.

B. Nondestructive Examination Summary Tables

The following section is the Nondestructive Examination Summary Table (Summary Table). The Summary Table lists the areas that were examined by SwRI personnel during this ISI. See Figure 1 for an explanation of the Summary Table format. Isometric figures depicting the location of Class 1 and Class 2 components are contained in Appendices A and B, respectively.

SALEM GENERATING STATION UNIT 2
SUMMARY OF NONDESTRUCTIVE EXAMINATIONS
OUTAGE 2 (1990), THIRD PERIOD, FIRST INTERVAL
CLASS 1 COMPONENTS

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**

The remarks column is used to describe any pertinent or unique features of the examination such as limitations, results, CNFs, etc. Ultrasonic calibration blocks are also listed in this column.

The results of the examination are indicated in these columns. The absence of recordable indications is shown by an "X" in the "NOREC" column. The presence of ultrasonic indications shown to be the result of a geometric feature of the examination area is indicated by an "X" in the "GEOM" column. The presence of nongeometric indications is indicated by an "X" in the "OTHER" column, and an explanation of the nature of each nongeometric indication is contained in the "REMARKS" column.

This column lists the applicable SwRI nuclear projects operating procedure used for the examination.

The NDE method used during the examination is listed in this column.

The ASME SECTION XI ITEM NO. and CATEGORY of the examination area are listed in this column.

Each examination area is listed in this column. Details of the weld identification system are contained in Appendices A and B.

This column references the examination summary sheet which serves as a cover sheet for the data package and lists the data record numbers, the examiners, and any pertinent remarks.

Figure 1. Explanation of Summary Table Format

REACTOR PRESSURE VESSEL (FIGURES A-1, 2, 3)

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	NOZZLE-TO-SAFE END WELDS							
004620	29-RC-1220-1 NOZZLE TO SAFE-END	B-F B1.6	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX. **37-SAM/76-SAM**
004630	29-RC-1210-1 NOZZLE TO SAFE-END	B-F B1.6	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX. **37-SAM/76-SAM**
004640	27.5-RC-1240-5 SAFE-END TO NOZZLE	B-F B1.6	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX. **37-SAM/76-SAM**
004650	27.5-RC-1230-5 SAFE-END TO NOZZLE	B-F B1.6	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX. **37-SAM/76-SAM**
004660	27.5-RC-1220-5 SAFE-END TO NOZZLE	B-F B1.6	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX. **37-SAM/76-SAM**
004670	27.5-RC-1210-5 SAFE-END TO NOZZLE	B-F B1.6	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX. **37-SAM/76-SAM**
	VESSEL INTERIOR AND CORE SUPPORT STRUCTURES							
006505	ACCESSIBLE INTERNAL SURFACES	B-N-1 B1.15	VT-1	SAM2-VT1	-	-	X	EXAMINED WITH CORE BARREL IN PLACE, WITH FUEL REMOVED. 5 LINEAR INDICATIONS DETECTED. SEE CNF 90-1. EXAMINATION OF INDICATION #4 WITH UT YIELDED INCONCLUSIVE RESULTS. ACCEPTED BY PSE&G "AS IS" FOR ANOTHER CYCLE OF USE.

PRESSURIZER (FIGURE A-5)

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	CIRCUMFERENTIAL WELDS							
010500	2-PZR-CIRC LHA LOWER HEAD TO SHELL A	B-B B2.1	UTOL	SAM2-UT15	X	-	-	EXAMINED 5% (18 INCHES) OF WELD. LIMITED EXAMINATION FROM SHELL A DUE TO INSULATION BRACKET. 68% OF CODE REQUIRED VOLUME EXAMINED. **42-SAM**
			UTOW		X	-	-	
			UT45		X	-	-	
			UT45T		X	-	-	
			UT60		X	-	-	
			UT60T		X	-	-	
010900	2-PZR-CIRC DUH SHELL D TO UPPER HEAD	B-B B2.1	UTOL	SAM2-UT15	X	-	-	EXAMINED 5% (18 INCHES) OF WELD. LIMITED EXAMINATION FROM THE UPPER HEAD DUE TO INSULATION SUPORT BRACKET. 57% OF CODE REQUIRED VOLUME EXAMINED. **42-SAM**
			UTOW		X	-	-	
			UT45		X	-	-	
			UT45T		X	-	-	
			UT60		X	-	-	
			UT60T		X	-	-	

STEAM GENERATORS (FIGURES A-6, 7, 8, 9)

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	CIRCUMFERENTIAL WELDS							
020100	24-STG-LHTS	B-B	UTOL	SAM2-UT15	X	-	-	EXAMINED 5% (24 INCHES) OF WELD.
	LOWER HEAD TO TUBE SHEET	B3.1	UTOW		X	-	-	LIMITED EXAMINATION FROM TUBE SHEET SIDE
			UT45		X	-	-	DUE TO TUBE SHEET CONFIGURATION. OVER
			UT45T		X	-	-	90% OF CODE REQUIRED VOLUME EXAMINED.
			UT60		X	-	-	**42-SAM**
			UT60T		X	-	-	
020400	21-STG-LHTS	B-B	UTOL	SAM2-UT15	X	-	-	EXAMINED 5% (24 INCHES) OF WELD.
	LOWER HEAD TO TUBE SHEET	B3.1	UTOW		X	-	-	LIMITED EXAMINATION FROM TUBE SHEET SIDE
			UT45		X	-	-	DUE TO TUBE SHEET CONFIGURATION. OVER
			UT45T		X	-	-	90% OF CODE REQUIRED VOLUME EXAMINED.
			UT60		X	-	-	**42-SAM**
			UT60T		X	-	-	
	NOZZLE INSIDE RADIUS SECTION							
020600	31-STG-1240-IRS	B-D	UT30	SAM2-UT11	X	-	-	LIMITED EXAMINATION DUE TO PERMANENT
	OUTLET NOZZLE IRS	B3.2						INSULATION SUPPORT. 85% OF CODE
								REQUIRED VOLUME EXAMINED.
								84-SAM
020900	31-STG-1210-IRS	B-D	UT30	SAM2-UT11	X	-	-	LIMITED EXAMINATION DUE TO PERMANENT
	OUTLET NOZZLE IRS	B3.2						INSULATION SUPPORT. 79% OF CODE
								REQUIRED VOLUME EXAMINED.
								84-SAM
021000	29-STG-1240-IRS	B-D	UT34	SAM2-UT11	X	-	-	LIMITED EXAMINATION DUE TO PERMANENT
	INLET NOZZLE IRS	B3.2						INSULATION SUPPORT. 86% OF CODE
								REQUIRED VOLUME EXAMINED.
								84-SAM
021300	29-STG-1210-IRS	B-D	UT34	SAM2-UT11	X	-	-	LIMITED EXAMINATION DUE TO PERMANENT
	INLET NOZZLE IRS	B3.2						INSULATION SUPPORT. 82% OF CODE
								REQUIRED VOLUME EXAMINED.
								84-SAM

CHEMICAL AND VOLUME CONTROL SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	3-CV-1241 [PSE&G #3"-2CV1000] (FIG NO A-12)							
034500	3-CV-1241-13	B-J	UTOL	SAM2-UT3	X	-	-	NO EXAMINATION FROM THE UPSTREAM SIDE
	VALVE TO ELBOW	B4.5	UTOW		X	-	-	DUE TO VALVE CONFIGURATION. UT
			UT45		X	-	-	PERFORMED AT THE REQUEST OF PSE&G
			UT45T		-	X	-	PERSONNEL FOR NRCB 88-08.
			UT60		X	-	-	**30-SAM**
034600	3-CV-1241-14	B-J	UTOL	SAM2-UT3	X	-	-	NO UT FROM THE DOWNSTREAM SIDE DUE TO
	ELBOW TO BRANCH CONNECTION	B4.5	UTOW		X	-	-	BRANCH CONNECTION CONFIGURATION. UT
			UT45		X	-	-	PERFORMED AT THE REQUEST OF PSE&G
			UT45T		X	-	-	PERSONNEL FOR NRCB 88-08.
			UT60		X	-	-	**30-SAM**
	2-CV-1275 [PSE&G #2"-2CV1156] (FIG NO A-15, 16)							
040900	2-CV-1275-43	B-J	PT	SAM2-PT1	X	-	-	NO UT ON WELD DUE TO WELD CONFIGURATION
	VALVE TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	AND LIMITED UT DOWNSTREAM DUE TO WELD
			UT45		X	-	-	44. UT PERFORMED AT THE REQUEST OF
			UT45T		X	-	-	PSE&G PERSONNEL FOR NRCB 88-08.
			UT60		X	-	-	**111-SAM**
041000	2-CV-1275-44	B-J	PT	SAM2-PT1	X	-	-	NO UT ON WELD DUE TO WELD CONFIGURATION
	PIPE TO BRANCH CONNECTION	B4.8	UTOL	SAM2-UT39	X	-	-	AND LIMITED UT UPSTREAM DUE TO WELD 43.
			UT45		X	-	-	UT PERFORMED AT THE REQUEST OF PSE&G
			UT45T		X	-	-	PERSONNEL FOR NRCB 88-08.
			UT70					**111-SAM**

PRESSURE RELIEF SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	3-PR-1207 [PSE&G #3"-2PS1028] (FIG NO A-23)							
055655	3-PR-1207-10C	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED WELD PLUS 2 1/2 INCHES FOR
	TEE TO CAP	B4.5	UT45		-	X	-	S2R200MFD416. NO EXAMINATION FROM THE
			UT45T		X	-	-	CAP SIDE DUE TO CAP CONFIGURATION.
			UT60		-	X	-	BASELINE EXAMINATION.
								30-SAM
	3-PR-1206 [PSE&G #3"-2PS1027] (FIG NO A-24)							
056855	3-PR-1206-10C	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED WELD PLUS 2 1/2 INCHES FOR
	TEE TO CAP	B4.5	UT45		-	X	-	S2R200MFD416. NO EXAMINATION FROM THE
			UT45T		X	-	-	CAP SIDE DUE TO CAP CONFIGURATION.
			UT60		-	X	-	BASELINE EXAMINATION.
								30-SAM

PRESSURIZING SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	14-PS-1231 [PSE&G #14"-2PS1016] (FIG NO A-25)							
060000	14-PS-1231-1	B-F	PT	SAM2-PT1	X	-	-	(BUTTERED WELD.) UTOL AND UTOW NOT
	NOZZLE TO PIPE	B4.1	UT45	SAM2-UT3	-	X	-	PERFORMED FOR ALARA PURPOSES. NO UT
			UT45T		X	-	-	FROM THE UPSTREAM SIDE DUE TO NOZZLE
			UT60		-	X	-	CONFIGURATION. AUGMENTED EXAMINATION
								PERFORMED 2ND CONSECUTIVE OUTAGE FOR
								NRCB 88-08.
								77-SAM
060200	14-PS-1231-2	B-J	PT	SAM2-PT1	X	-	-	UTOL NOT PERFORMED FOR ALARA PURPOSES.
	PIPE TO PIPE	B4.5	UT45	SAM2-UT3	-	X	-	AUGMENTED EXAMINATION PERFORMED 2ND
			UT45T		X	-	-	CONSECUTIVE OUTAGE FOR NRCB 88-08.
			UT60		-	X	-	
								77-SAM
060300	14-PS-1231-3	B-J	PT	SAM2-PT1	X	-	-	UTOL NOT PERFORMED FOR ALARA PURPOSES.
	PIPE TO PIPE	B4.5	UT45	SAM2-UT3	-	X	-	AUGMENTED EXAMINATION PERFORMED 2ND
			UT45T		X	-	-	CONSECUTIVE OUTAGE FOR NRCB 88-08.
			UT60		-	X	-	
								77-SAM
060400	14-PS-1231-4	B-J	PT	SAM2-PT1	X	-	-	UTOL AND UTOW NOT PERFORMED FOR ALARA
	PIPE TO BRANCH CONNECTION	B4.5	UT45	SAM2-UT3	-	X	-	PURPOSES. NO UT FROM THE DOWNSTREAM
			UT45T		X	-	-	SIDE DUE TO BRANCH CONNECTION
			UT60		-	X	-	CONFIGURATION. AUGMENTED EXAMINATION
								PERFORMED 2ND CONSECUTIVE OUTAGE FOR
								NRCB 88-08.
								77-SAM

REACTOR COOLANT SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	31-RC-1240 [PSE&G #31"-2RC1010] (FIG NO A-29)							
071600	31-RC-1240-4/3-RC-1243 3 IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	
	31-RC-1230 [PSE&G #31"-2RC1007] (FIG NO A-30)							
073500	31-RC-1230-4LU-I LONGITUDINAL	B-J B4.5	PT	SAM2-PT1 -	- X	- -	X -	NO UT FROM EITHER SIDE OF WELD DUE TO ACOUSTIC PROPERTIES OF CASTING. PT PERFORMED INSTEAD OF UT. INITIAL EXAMINATION REVEALED 2 ROUND INDICATIONS. REEXAMINATION PROVED INDICATIONS NON-RELEVANT. **37-SAM**
073600	31-RC-1230-4LU-O LONGITUDINAL	B-J B4.5	PT	SAM2-PT1	X	-	-	NO UT FROM EITHER SIDE OF WELD DUE TO ACOUSTIC PROPERTIES OF CASTING. PT PERFORMED INSTEAD OF UT. **37-SAM**
073700	31-RC-1230-4 ELBOW TO PIPE	B-J B4.5	PT UTOL UTOW UT45 UT45T UT60	SAM2-PT1 SAM2-UT3	X X X X X -	- - - - - X	- - - - - -	NO UT FROM UPSTREAM SIDE DUE TO ACOUSTIC PROPERTIES OF CASTING. LIMITED UT FROM DOWNSTREAM SIDE DUE TO BRANCH CONNECTION CONFIGURATION. PT PERFORMED TO SUPPLEMENT UT. **37-SAM**
073900	31-RC-1230-4/3-RC-1233 3 IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	
	31-RC-1210 [PSE&G #31"-2RC1001] (FIG NO A-32)							
078000	31-RC-1210-4LU-I LONGITUDINAL	B-J B4.5	PT	SAM2-PT1	X	-	-	NO UT FROM EITHER SIDE OF WELD DUE TO ACOUSTIC PROPERTIES OF CASTING. PT PERFORMED INSTEAD OF UT. **37-SAM**

REACTOR COOLANT SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	31-RC-1210 [PSE&G #31"-2RC1001] (FIG NO A-32)							
078100	31-RC-1210-4LU-O LONGITUDINAL	B-J B4.5	PT	SAM2-PT1	X	-	-	NO UT FROM EITHER SIDE OF WELD DUE TO ACOUSTIC PROPERTIES OF CASTING. PT PERFORMED INSTEAD OF UT. **37-SAM**
078200	31-RC-1210-4 ELBOW TO PIPE	B-J B4.5	PT	SAM2-PT1	X	-	-	NO UT FROM UPSTREAM SIDE DUE TO ACOUSTIC PROPERTIES OF CASTING. LIMITED UT FROM DOWNSTREAM SIDE DUE TO BRANCH CONNECTION CONFIGURATION. PT PERFORMED TO SUPPLEMENT UT. **37-SAM**
			UTOL	SAM2-UT3	X	-	-	
			UTOW		X	-	-	
			UT45		X	-	-	
			UT45T		X	-	-	
			UT60		X	-	-	
	29-RC-1240 [PSE&G #29"-2RC1009] (FIG NO A-33)							
079300	29-RC-1240-3 PIPE TO PIPE	B-J B4.5	UTOL	SAM2-UT3	X	-	-	**37-SAM**
			UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	
080000	29-RC-1240-5 ELBOW TO NOZZLE	B-F B4.1	PT	SAM2-PT1	X	-	-	NO UT FROM UPSTREAM AND DOWNSTREAM SIDES DUE TO ELBOW ACOUSTIC PROPERTIES AND NOZZLE CONFIGURATION. **37-SAM**
			UTOL	SAM2-UT3	X	-	-	
			UTOW		X	-	-	
			UT45T		X	-	-	
	29-RC-1230 [PSE&G #29"-2RC1006] (FIG NO A-34)							
081200	29-RC-1230-5 ELBOW TO NOZZLE	B-F B4.1	PT	SAM2-PT1	X	-	-	NO UT FROM UPSTREAM AND DOWNSTREAM SIDE DUE TO ELBOW ACOUSTIC PROPERTIES AND NOZZLE CONFIGURATION. **37-SAM**
			UTOL	SAM2-UT3	X	-	-	
			UTOW		X	-	-	
			UT45T		X	-	-	

REACTOR COOLANT SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	29-RC-1220 [PSE&G #29"-2RC1003] (FIG NO A-35)							
081400	29-RC-1220-2 SAFE-END TO PIPE	B-J B4.5	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX TO SUPPLEMENT UT. **37-SAM**
081500	29-RC-1220-3 PIPE TO PIPE	B-J B4.5	UTOL UT45 UT45T UT60	SAM2-UT3	X - X X	- X - -	- - - -	**37-SAM**
081700	29-RC-1220-3/6-SJ-1221 6 IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	
082200	29-RC-1220-5 ELBOW TO NOZZLE	B-F B4.1	PT UTOL UTOW UT45T	SAM2-PT1 SAM2-UT3	X X X X	- - - -	- - - -	NO UT FROM UPSTREAM AND DOWNSTREAM SIDES DUE TO ELBOW ACOUSTIC PROPERTIES AND NOZZLE CONFIGURATION. **37-SAM**
	29-RC-1210 [PSE&G #29"-2RC1000] (FIG NO A-36)							
082400	29-RC-1210-2 SAFE-END TO PIPE	B-J B4.5	PT	SAM2-PT1	X	-	-	PERFORMED PT ONLY IN SANDBOX TO SUPPLEMENT UT. **37-SAM**
	27.5-RC-1240 [PSE&G #27-1/2"-2RC1011] (FIG NO A-37)							
083600	27.5-RC-1240-1/2-RC-1242 2 IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	

REACTOR COOLANT SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	27.5-RC-1230 [PSE&G #27-1/2"-2RC1008] (FIG NO A-38)							
084800	27.5-RC-1230-1/3-CV-1231 3 IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	
	27.5-RC-1220 [PSE&G #27-1/2"-2RC1005] (FIG NO A-39)							
086000	27.5-RC-1220-1/1.5-SJ-1221 1 1/2IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	
086200	27.5-RC-1220-3 PIPE TO ELBOW	B-J B4.5	PT UTOL UTOW UT45 UT45T UT60	SAM2-PT1 SAM2-UT3	X X X - X -	- - - X - X	- - - - - -	NO UT FROM DOWNSTREAM SIDE DUE TO ACOUSTIC PROPERTIES OF CASTING. PT PERFORMED TO SUPPLEMENT UT. **37-SAM**
	27.5-RC-1210 [PSE&G #27-1/2"-2RC1002] (FIG NO A-40)							
086700	27.5-RC-1210-1/2-RC-1212 2 IN. BRANCH CONNECTION	B-J B4.7	PT	SAM2-PT1	X	-	-	
086800	27.5-RC-1210-1/10-SJ-1211 10 IN. BRANCH CONNECTION	B-J B4.6	PT UTOL UT45 UT45T	SAM2-PT1 SAM3-UT3	X X X X	- - - -	- - - -	NO UT ON WELD DUE TO WELD CONFIGURATION. LIMITED UT DUE TO ADJACENT BRANCH CONNECTION. 74% OF CODE REQUIRED VOLUME EXAMINED. PT PERFORMED TO SUPPLEMENT UT. **37-SAM**
	2-RC-1241 [PSE&G #2"-2RC1110] (FIG NO A-47)							
100300	2-RC-1241-4 VALVE TO PIPE	B-J B4.8	PT	SAM2-PT1	X	-	-	

REACTOR COOLANT SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	2-RC-1231 [PSE&G #2"-2RC1087] (FIG NO A-50)							
105300	2-RC-1231-1 BRANCH CONNECTION TO PIPE	B-J B4.8	PT	SAM2-PT1	X	-	-	
105400	2-RC-1231-2 PIPE TO VALVE	B-J B4.8	PT	SAM2-PT1	X	-	-	

RESIDUAL HEAT REMOVAL SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	14-RH-1211 [PSE&G #14"-2RH1000] (FIG NO A-61)							
150400	14-RH-1211-3	B-J	UTOL	SAM2-UT3	X	-	-	LIMITED UT FROM DOWNSTREAM SIDE DUE TO
	ELBOW TO PIPE	B4.5	UTOW		X	-	-	PIPE RESTRAINT. 68% OF CODE REQUIRED
			UT45		-	X	-	VOLUME EXAMINED. EXAMINED PER 76-06
			UT45T		X	-	-	REQUIREMENTS.
			UT60		-	X	-	**78-SAM**
150500	14-RH-1211-4	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	PIPE TO ELBOW	B4.5	UTOW		X	-	-	
			UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	**78-SAM**

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	10-SJ-1211 [PSE&G #10"-2SJ1036] (FIG NO A-66)							
164750	10-SJ-1211-12	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	PIPE TO ELBOW	B4.5	UTOW		X	-	-	
			UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	**22-SAM**
	6-SJ-1241 [PSE&G #6"-2SJ1170] (FIG NO A-74, 75)							
172300	6-SJ-1241-14	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	PIPE TO ELBOW	B4.5	UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	
								25-SAM
172350	6-SJ-1241-15	B-J	UTOL	SAM2-UT3	X	-	-	NO UT FROM DOWNSTREAM SIDE DUE TO VALVE
	ELBOW TO VALVE	B4.5	UTOW		X	-	-	CONFIGURATION. EXAMINED PER 76-06
			UT45		-	X	-	REQUIREMENTS.
			UT45T		X	-	-	
			UT60		-	X	-	**25-SAM**
	6-SJ-1232 [PSE&G #6"-2SJ1050] (FIG NO A-76)							
173100	6-SJ-1232-8	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	PIPE TO ELBOW	B4.5	UTOW		X	-	-	
			UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	**25-SAM**
	6-SJ-1231 [PSE&G #6"-2SJ1171] (FIG NO A-77, 78)							
174200	6-SJ-1231-14	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	ELBOW TO PIPE	B4.5	UTOW		X	-	-	
			UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	**25-SAM**

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	6-SJ-1222 [PSE&G #6"-2SJ1028] (FIG NO A-79)							
174650	6-SJ-1222-3	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	PIPE TO ELBOW	B4.5	UT45		-	X	-	
			UT45T		X	-	-	
			UT60		-	X	-	
								25-SAM
	3-SJ-1292 [PSE&G #3"-2SJ1012] (FIG NO A-88)							
182800	3-SJ-1292-2	B-J	UTOL	SAM2-UT3	X	-	-	NO UT FROM DOWNSTREAM SIDE DUE TO TEE
	PIPE TO TEE	B4.5	UTOW		X	-	-	CONFIGURATION. EXAMINED PER 76-06
			UT45		X	-	-	REQUIREMENTS.
			UT45T		X	-	-	
			UT60		X	-	-	**30-SAM**
183000	3-SJ-1292-5	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	PIPE TO ELBOW	B4.5	UT45		-	X	-	
			UT45T		X	-	-	
			UT60		X	-	-	
								30-SAM
183050	3-SJ-1292-6	B-J	UTOL	SAM2-UT3	X	-	-	EXAMINED PER 76-06 REQUIREMENTS.
	ELBOW TO PIPE	B4.5	UT45		X	-	-	
			UT45T		X	-	-	
			UT60		X	-	-	
								30-SAM
	2-SJ-1249 [PSE&G #2"-2SJ1116] (FIG NO A-89, 90)							
184600	2-SJ-1249-10	B-J	PT	SAM2-PT1	X	-	-	
	PIPE TO ELBOW	B4.8						
184650	2-SJ-1249-11	B-J	PT	SAM2-PT1	X	-	-	
	ELBOW TO PIPE	B4.8						

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	2-SJ-1249 [PSE&G #2"-2SJ1116] (FIG NO A-89, 90)							
184700	2-SJ-1249-12 PIPE TO TEE	B-J B4.8	PT	SAM2-PT1	X	-	-	
184750	2-SJ-1249-13 TEE TO REDUCER	B-J B4.8	PT	SAM2-PT1	X	-	-	
	2-SJ-1229 [PSE&G #2"-2SJ1115] (FIG NO A-94, 95)							
191800	2-SJ-1229-18 ELBOW TO PIPE	B-J B4.8	PT	SAM2-PT1	X	-	-	
191950	2-SJ-1229-21 PIPE TO ELBOW	B-J B4.8	PT	SAM2-PT1	X	-	-	
192000	2-SJ-1229-22 ELBOW TO PIPE	B-J B4.8	PT	SAM2-PT1	X	-	-	
	2-SJ-1228 [PSE&G #2"-2SJ1047] (FIG NO A-96, 97)							
195150	2-SJ-1228-38 PIPE TO COUPLING	B-J B4.8	PT	SAM2-PT1	X	-	-	
195200	2-SJ-1228-39 COUPLING TO PIPE	B-J B4.8	PT	SAM2-PT1	X	-	-	

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	2-SJ-1228 [PSE&G #2"-2SJ1047] (FIG NO A-96, 97)							
195850	2-SJ-1228-52	B-J	PT	SAM2-PT1	X	-	-	
	ELBOW TO PIPE	B4.8						
195900	2-SJ-1228-53	B-J	PT	SAM2-PT1	X	-	-	
	PIPE TO ELBOW	B4.8						
196350	2-SJ-1228-62	B-J	PT	SAM2-PT1	X	-	-	NO UT FROM DOWNSTREAM SIDE DUE TO
	PIPE TO REDUCER	B4.5	UTOL	SAM2-UT32	X	-	-	REDUCER CONFIGURATION. PT PERFORMED TO
			UT45		X	-	-	SUPPLEMENT UT.
			UT45T		X	-	-	
								39-SAM
	1.5-SJ-1242 [PSE&G #1-1/2"-2SJ1016] (FIG NO A-101, 102)							
202000	1.5-SJ-1242-39	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	VALVE TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
202050	1.5-SJ-1242-40	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO ELBOW	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
202100	1.5-SJ-1242-41	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	ELBOW TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	1.5-SJ-1242 [PSE&G #1-1/2"-2SJ1016] (FIG NO A-101, 102)							
202150	1.5-SJ-1242-42	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO BRANCH CONNECTION	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
	1.5-SJ-1232 [PSE&G #1-1/2"-2SJ1015] (FIG NO A-103, 104)							
203850	1.5-SJ-1232-33	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	VALVE TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
203900	1.5-SJ-1232-34	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO ELBOW	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
203950	1.5-SJ-1232-35	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	ELBOW TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
204000	1.5-SJ-1232-36	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO BRANCH CONNECTION	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
	1.5-SJ-1222 [PSE&G #1-1/2"-2SJ1013] (FIG NO A-105, 106)							
206350	1.5-SJ-1222-46	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	VALVE TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	1.5-SJ-1222 [PSE&G #1-1/2"-2SJ1013] (FIG NO A-105, 106)							
206400	1.5-SJ-1222-47	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO ELBOW	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
206450	1.5-SJ-1222-48	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	ELBOW TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
206500	1.5-SJ-1222-49	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO BRANCH CONNECTION	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
	1.5-SJ-1212 [PSE&G #1-1/2"-2SJ1014] (FIG NO A-107, 108)							
208700	1.5-SJ-1212-43	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	VALVE TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
208750	1.5-SJ-1212-44	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO ELBOW	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**
208800	1.5-SJ-1212-45	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	ELBOW TO PIPE	B4.8	UTOL	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**

SAFETY INJECTION SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	1.5-SJ-1212 [PSE&G #1-1/2"-2SJ1014] (FIG NO A-107, 108)							
208850	1.5-SJ-1212-46	B-J	PT	SAM2-PT1	X	-	-	NO UT45T ON WELD DUE TO WELD
	PIPE TO BRANCH CONNECTION	B4.8	UT0L	SAM2-UT39	X	-	-	CONFIGURATION. UT PERFORMED AT REQUEST
			UT45		X	-	-	OF PSE&G PERSONNEL FOR NRCB 88-08 2ND
			UT45T		X	-	-	CONSECUTIVE INTERVAL.
			UT70		X	-	-	**111-SAM**

REACTOR COOLANT PUMPS (FIGURE A-109)

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	BOLTING							
250100	24-PMP-BOLTS 1-24	B-G-1	UT45	SAM2-UT18	X	-	-	EXAMINED 24 BOLTS IN PLACE.
		B5.1	UT60		X	-	-	
			UT88		X	-	-	
								70-SAM
250400	21-PMP-BOLTS 1-24	B-G-1	UT45	SAM2-UT18	-	-	-	EXAMINED BOLTS IN PLACE. NO EXAMINATION
		B5.1	UT60		-	-	-	OF BOLTS 7, 8, 11 AND 21 DUE TO
			UT88					INACCESSIBILITY.
								70-SAM
	PUMP CASING WELDS							
251500	RCP CASING WELDS PUMP 21	B-L-1 B5.6	PT	SAM2-PT3	X	-	-	NO UT DUE TO ACOUSTIC PROPERTIES OF PUMP. PT PERFORMED INSTEAD OF UT.
	PUMP MOTOR FLYWHEELS							
252200	23-PMP-FLW	RG 1.14	UTOL	SAM2-UT6	X	-	-	EXAMINED IN PLACE IN (TOP SIDE ONLY) IN
			UT45		X	-	-	ACCORDANCE WITH REG GUIDE 1.14.
								42-SAM
252300	22-PMP-FLW	RG 1.14	MT	SAM2-MT1	X	-	-	EXAMINED REMOVED AT WESTINGHOUSE PLANT.
				ICN-1				NUMEROUS (21) TOOL CHATTER INDICATIONS
			PT	SAM2-PT1	-	-	X	OBSERVED IN THE 3 BORE KEYWAYS.
				ICN-1				SEE CNF FW-001.
			UTOL	SAM2-UT6	X	-	-	**42-SAM/50-SAM**
			UT45		-	X	-	
252410	FLYWHEEL 12	RG 1.14	UTOL	SAM2-UT6	X	-	-	EXAMINED IN PLACE, TOP SIDE ONLY IN
			UT45		X	-	-	ACCORDANCE WITH REG. GUIDE 1.14.
								42-SAM

STEAM GENERATORS (FIGURES B-1, 2, 3, 4)

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	BOLTING							
274400	23-STG-MB90	C-D	VT	SAM2-VT1	X	-	-	EXAMINED.1 REPLACEMENT BOLT REMOVED.
	BOLTS-MANWAY AT 90 DEG.	C1.4	UTO	SAM2-UT36	X	-	-	
								100-SAM

REACTOR COOLANT FILTER (FIGURE 8-9)

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	CIRCUMFERENTIAL WELDS							
275230	2-RCF-1 UPPER HEAD TO FLANGE	C-A C1.1	UTOL UT45 UT45T	SAM2-UT26	X - X	- X -	- - -	WELD LENGTH = 43.9". EXAMINED 20% (12") FROM L=41.9" TO 2", 13" TO 17" AND 27" TO 31. NO EXAM FROM THE FLANGE SIDE DUE TO FLANGE CONFIGURATION. NO UT45T ON WELD DUE WELD CONFIGURATION. 50% OF CODE REQUIRED VOLUME EXAMINED. W.O. 88-052147, ACT 4. **96-SAM**
	INTEGRALLY WELDED SUPPORTS							
275260	2-RCF-1VS THRU 4VS VESSEL SUPPORT	C-C C1.3	PT	SAM2-PT1	X	-	-	EXAMINED ON WORK ORDER 88-0523147, ACT. 4.

MAIN STEAM SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	6-MS-2231 [PSE&G #6"-2MS1058] (FIG NO B-43, 44)							
384661	6-MS-2231-7R	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION.
	PIPE TO BEND	C2.1	UTOL	SAM2-UT3	X	-	-	
			UT45		-	X		
			UT45T		X	-	-	
			UT60		-	X		**49-SAM**
384683	6-MS-2231-9A	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION. NO UT FROM THE
	PIPE TO VALVE 23-MS-46	C2.1	UTO	SAM2-UT3	X	-	-	DOWNSTREAM SIDE DUE TO VALVE
			UTOW		X	-	-	CONFIGURATION. 80% OF CODE REQUIRED
			UT45		-	X	-	VOLUME EXAMINED.
			UT45T		X	-	-	**49-SAM**
			UT60		-	X	-	
384685	6-MS-2231-9B	C-G	MT	SAM2-MT1T	X	-	-	BASELINE EXAMINATION. NO UT FROM THE
	VALVE 23-MS-46 TO PIPE	C2.1	UTO	SAM2-UT3	X	-	-	UPSTREAM SIDE DUE TO VALVE
			UTOW		X	-	-	CONFIGURATION. 80% OF CODE REQUIRED
			UT45		-	X	-	VOLUME EXAMINED.
			UT45T		X	-	-	**49-SAM**
			UIT60		-	X	-	
384715	6-MS-2231-11R	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION.
	ELBOW TO PIPE	C2.1	UTO	SAM2-UT3	X	-	-	
			UT45		X	-	-	
			UT45T		X	-	-	
			UT60		-	X	-	**49-SAM**
384725	6-MS-2231-12R	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION.
	PIPE TO PIPE	C2.1	UTO	SAM2-UT3	X	-	-	
			UT45		X	-	-	
			UT45T		X	-	-	
			UT60		-	X	-	**49-SAM**
	6-MS-2211 [PSE&G #6"-2MS1056] (FIG NO B-45)							
385545	6-MS-2211-16A	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION. NO UT FROM THE
	PIPE TO VALVE 21-MS-191	C2.1	UTO	SAM2-UT3	X	-	-	DOWNSTREAM SIDE DUE TO VALVE
			UTOW		X	-	-	CONFIGURATION. 72% OF CODE REQUIRED
			UT45		-	X	-	VOLUME EXAMINED.
			UT45T		-	X	-	**49-SAM**
			UT60		-	X	-	

MAIN STEAM SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	6-MS-2211 [PSE&G #6"-2MS1056] (FIG NO B-45)							
385548	6-MS-2211-16B	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION. NO UT FROM THE
	VALVE 21-MS-191 TO PIPE	C2.1	UT0	SAM2-UT3	X	-	-	UPSTREAM SIDE DUE TO VALVE
			UT0W		X	-	-	CONFIGURATION. 73% OF CODE REQUIRED
			UT45		-	X	-	VOLUME EXAMINED.
			UT45T		-	X	-	**49-SAM**
			UT60		-	X	-	
385585	6-MS-2211-20R	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION.
	ELBOW TO PIPE	C2.1	UT0	SAM2-UT3	X	-	-	
			UT45		X	-	-	
			UT45T		-	X	-	
			UT60		-	X	-	**49-SAM**
385595	6-MS-2211-21R	C-G	MT	SAM2-MT1	X	-	-	BASELINE EXAMINATION.
	PIPE TO PIPE	C2.1	UT0	SAM2-UT3	X	-	-	
			UT45		-	X	-	
			UT45T		-	X	-	
			UT60		-	X	-	**49-SAM**

RESIDUAL HEAT REMOVAL SYSTEM

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	8-RH-2273 [PSE&G #8"-2RH1016] (FIG NO B-59)							
502493	8-RH-2273-9PS-1 PIPE SUPPORT	C-E-1 C2.5	PT	SAM2-PT1	X	-	-	

VALVES

SUMMARY NUMBER	EXAMINATION AREA IDENTIFICATION	ASME SEC. XI CATGY ITEM NO	EXAM METHOD	PROCEDURE	NOREC	GEOM	OTHER	REMARKS **CALIBRATION BLOCK**
	BOLTING							
600600	24 MS 167	C-D	VT	SAM2-VT1	X	-	-	EXAMINED 20 (100%) STUDS AND NUTS EACH
	ON LINE 34-MS-2241 (FIG. B-26)	C4.2	UTO	SAM2-UT36	X	-	-	IN TOP AND BOTTOM WITH VT. EXAMINED 2
			UTO	SAM2-UT37	-	X	-	(10%) STUDS AND NUTS EACH IN TOP AND
			UT45		X	-	-	BOTTOM WITH UT. HARD YELLOW CHEMICAL
								BUILD UP ON UPPER STUDS AND NUTS. SEE
								CNF 90-3. ACCEPTED "AS IS".
								81-SAM/82-SAM
600950	24 MS 14	C-D	VT	SAM2-VT1	X	-	-	EXAMINED 6 (100%) STUDS AND NUTS WITH
	ON LINE 8-MS-2244 (FIG. B-38)	C4.2	UTO	SAM2-UT36	X	-	-	VT. EXAMINED 2 (10%) STUDS AND NUTS
			UTO	SAM2-UT37	X	-	-	WITH UT.
			UT45		X	-	-	
								87-SAM/101-SAM
601300	23 MS 14	C-D	VT	SAM2-VT1	X	-	-	EXAMINED 6 (100%) STUDS AND NUTS WITH
	ON LINE 8-MS-2234 (FIG. B-39)	C4.2	UTO	SAM2-UT36	X	-	-	UT. EXAMINED 2 (10%) STUDS AND NUTS
			UTO	SAM2-UT37	X	-	-	WITH UT.
			UT45		X	-	-	
								87-SAM/101-SAM

APPENDIX A

WELD IDENTIFICATION DRAWINGS - CLASS 1

APPENDIX A

WELD IDENTIFICATION DRAWINGS - CLASS 1

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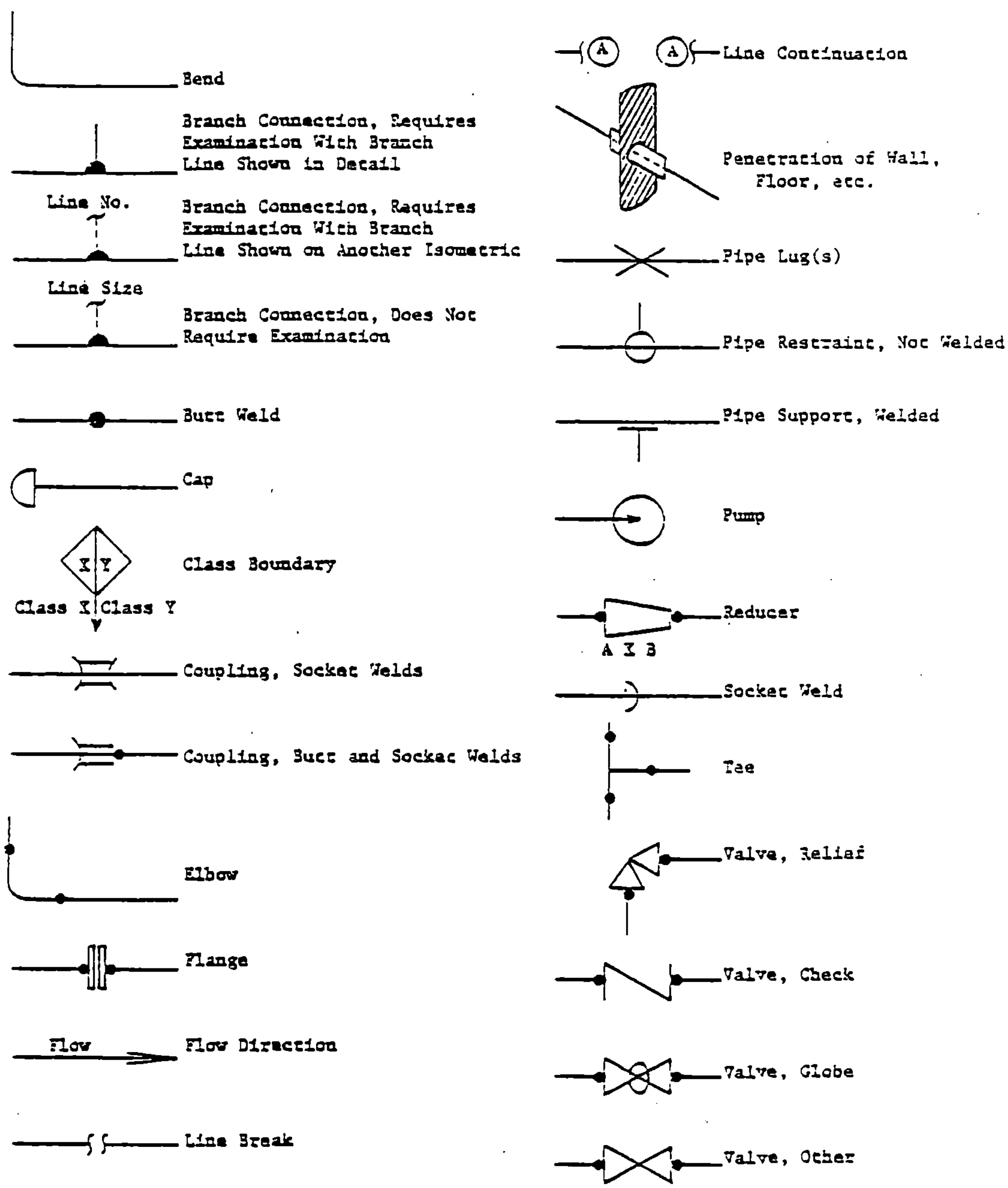


SYMBOLS FOR WELD IDENTIFICATION

Examination Area Identification System

1. Vessels

For Vessel examination area, the following format is used:

A-B-C

where: A is the number "2" and denotes Salem Unit 2 except for nozzles and Steam Generators. For nozzles, A is the same as the connecting line size. For Steam Generators, A is the same as the Steam Generator number.

where: B denotes the vessel, as follows:

PZR	-	Pressurizer
PRN	-	Pressurizer Nozzles
RPV	-	Reactor Pressure Vessel
RPVCH	-	Reactor Presure Vessel Closure Head
RCN	-	Steam Generator Nozzles
STG	-	Steam Generator

where: C is a unique number or letter identifying the examination area. For RPV circumferential, meridional, and longitudinal welds, C is the same number that Westinghouse assigned to the weld. C ends in IRS for inside radius section examination areas.

Examples:

2-RPV-2042A
- 2042A — Unique Number (Westinghouse number)
- RPV — Reactor Pressure Vessel
- 2 — Unit 2

21-STG-25
- 25 — Unique Number
- STG — Steam Generator
- 21 — Steam Generator No. 21

4-PRN-1203-IRS
- IRS — Inside Radius Section
- 1203 — Unique Number
- PRN — Pressurizer Nozzle
- 4 — Nozzle for 4-in. Line

2. Piping

For piping welds, the following format is used:

AA-BB-CDEE-F-(-G)

where: AA denotes the nominal pipe diameter of the line.

where: BB denotes the piping system associated with the line (determined by PSE&G valve nomenclature), as follows:

BF - Steam Generator Feed
CS - Containment Spray
CV - Chemical and Volume Control System
MS - Main Steam
PR - Pressurizer Relief
PS - Pressurizer System
RC - Reactor Coolant
RH - Residual Heat Removal
SJ - Safety Injection

where: C has the following options:

1 - Class 1 examination areas
2 - Class 2 examination areas

where: D is the integer 2 and denotes Salem Unit 2.

where: EE is two integers asigned to assure uniqueness. For the Main Reactor Coolant Loops, the first integer correlates with the loop number and the second integer is zero.

where: F is assigned to assure uniqueness and to designate the type of weld as follows:

a. If only a one- or two-digit integer appears, this indicates a circumferential weld. The welds are numbered consecutively in the direction of flow. Where the direction of flow is ambiguous, a flow direction is assumed.

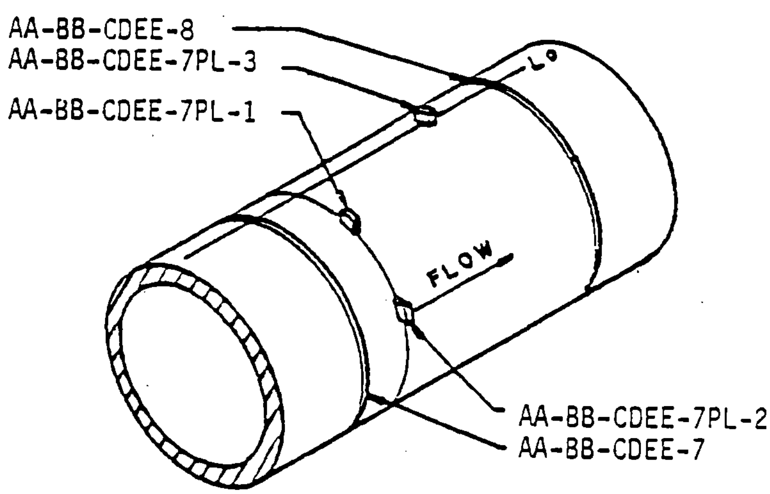
b. For other than circumferential welds, except branch connections, two letters are added to the circumferential weld number which either intersects the weld (in the case of the longitudinal welds) or is upstream from the component, as follows:

FB - Flange Bolting
LU - Longitudinal Seam Weld Extending Upstream
LD - Longitudinal Seam Weld Extending Downstream
PL - Pipe Lug (Welded)
PS - Pipe Support (Welded)

SC - Support Component Portion of A Welded Pipe Support
PR - Non-Welded Pipe Restraint

where: G is an integer assigned when there is more than one component [see (2) above] of one type or a longitudinal weld between successive circumferential welds. This number increases either sequentially from the upstream weld or clockwise from Lo, a standard reference location used for piping (see examples). On double seamed elbows, the weld located along the outside radius is denoted by the letter "O", and the weld located along the inside radius is denoted by the letter "I".

Example:



For branch connections exceeding 1-in. diameter nominal pipe size for Class 1 and 4-in. diameter nominal pipe size for Class 2, both the main run and branch line are identified and separated by a diagonal slash (/). To locate the branch connection, the upstream circumferential weld on the main run is also identified.

Example: 29-RC-1210-2/14-RH-1111 is the branch connection from the line 29-RC-1210 downstream from weld Number 2 which connects line 14-RH-1211.

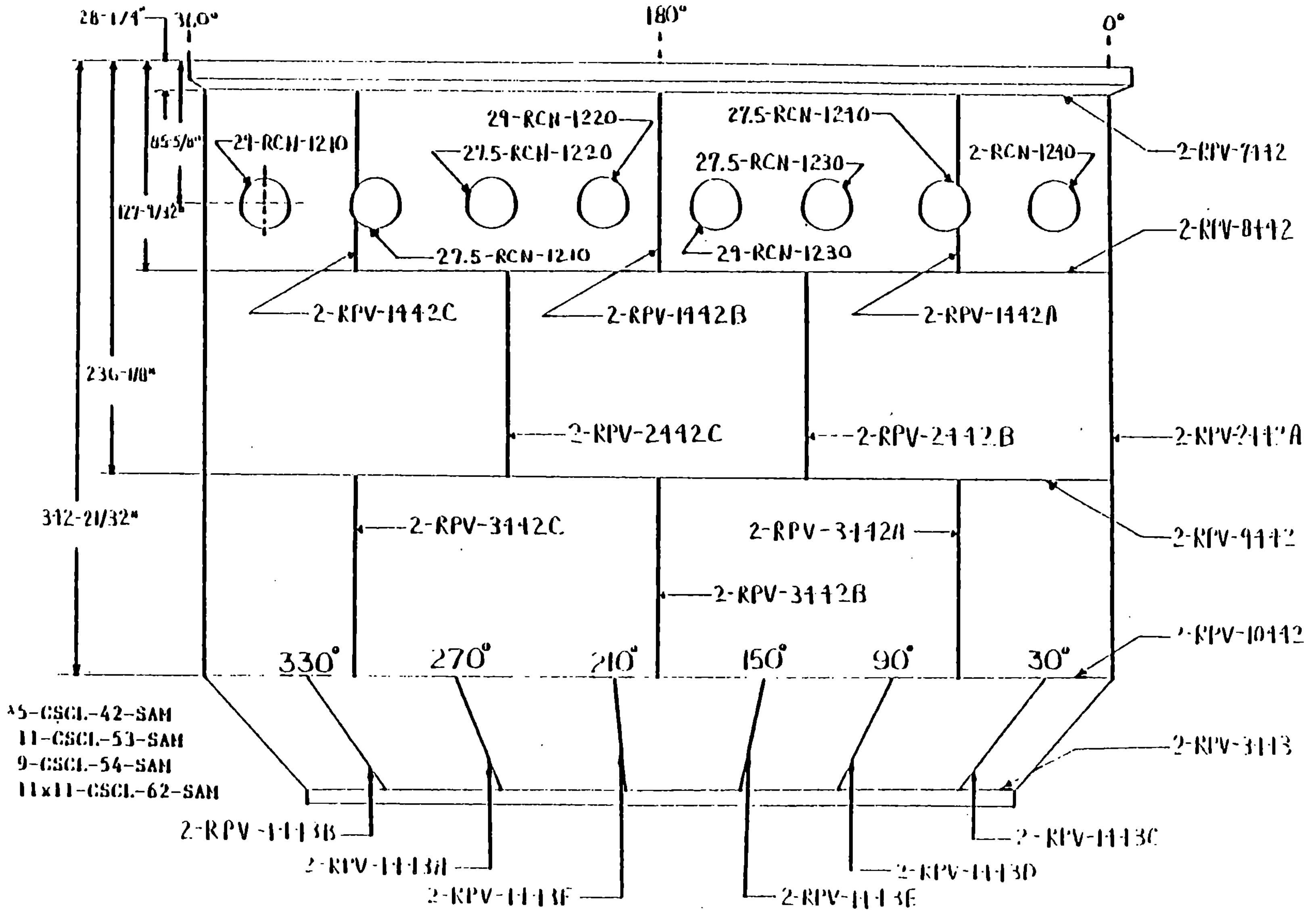
3. Pumps

The RC pump examination areas are each identified by a two-digit number which identifies the pump number, i.e., 21, 22, 23, or 24. Following the pump number are the three letters "PMP" used with the RC pump identification and a group of numbers and/or letters making each area uniquely numbered. The RH pumps are identified similarly except that the three letters are "RHR".

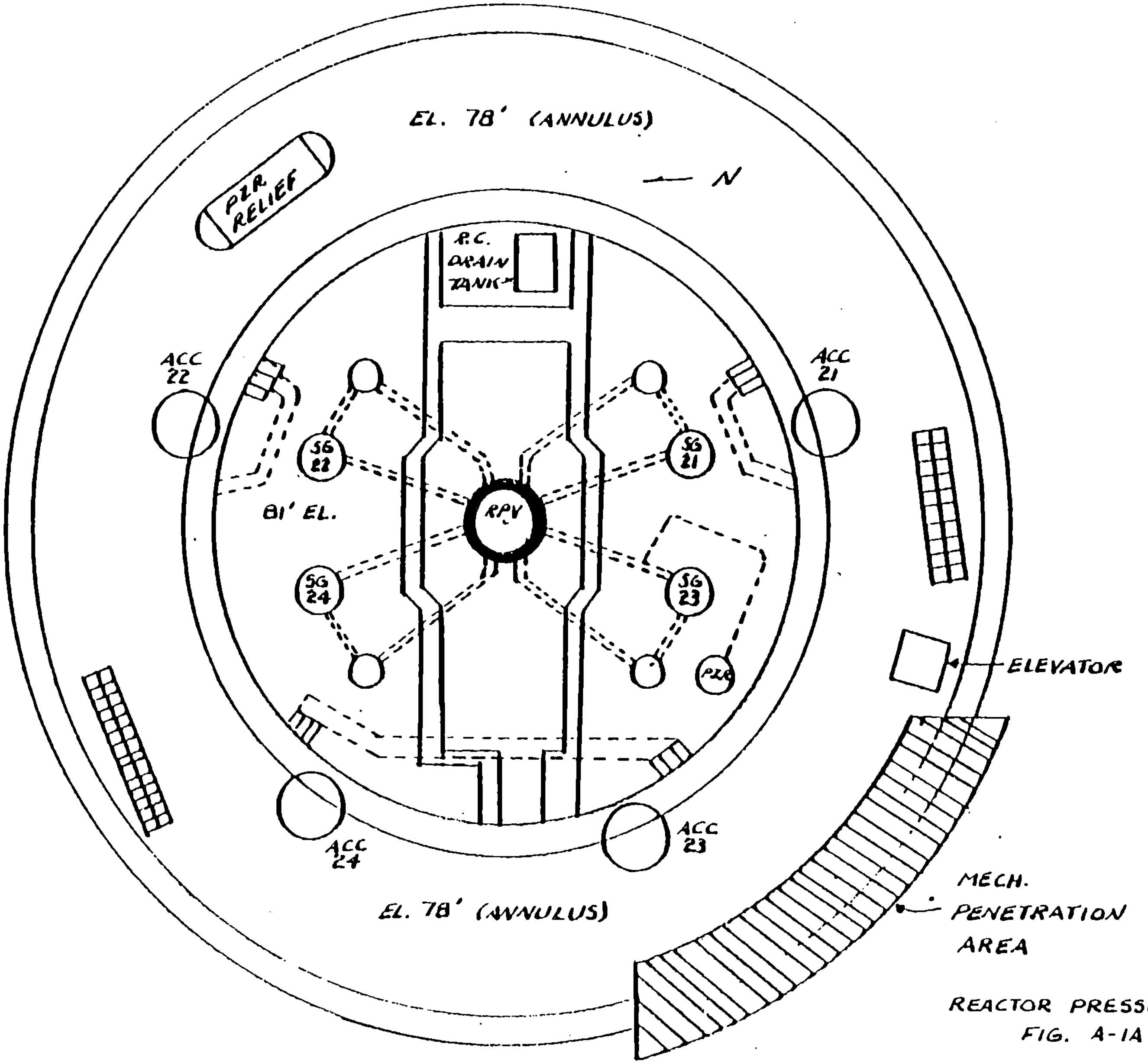
Example:

21-PMP-FLW

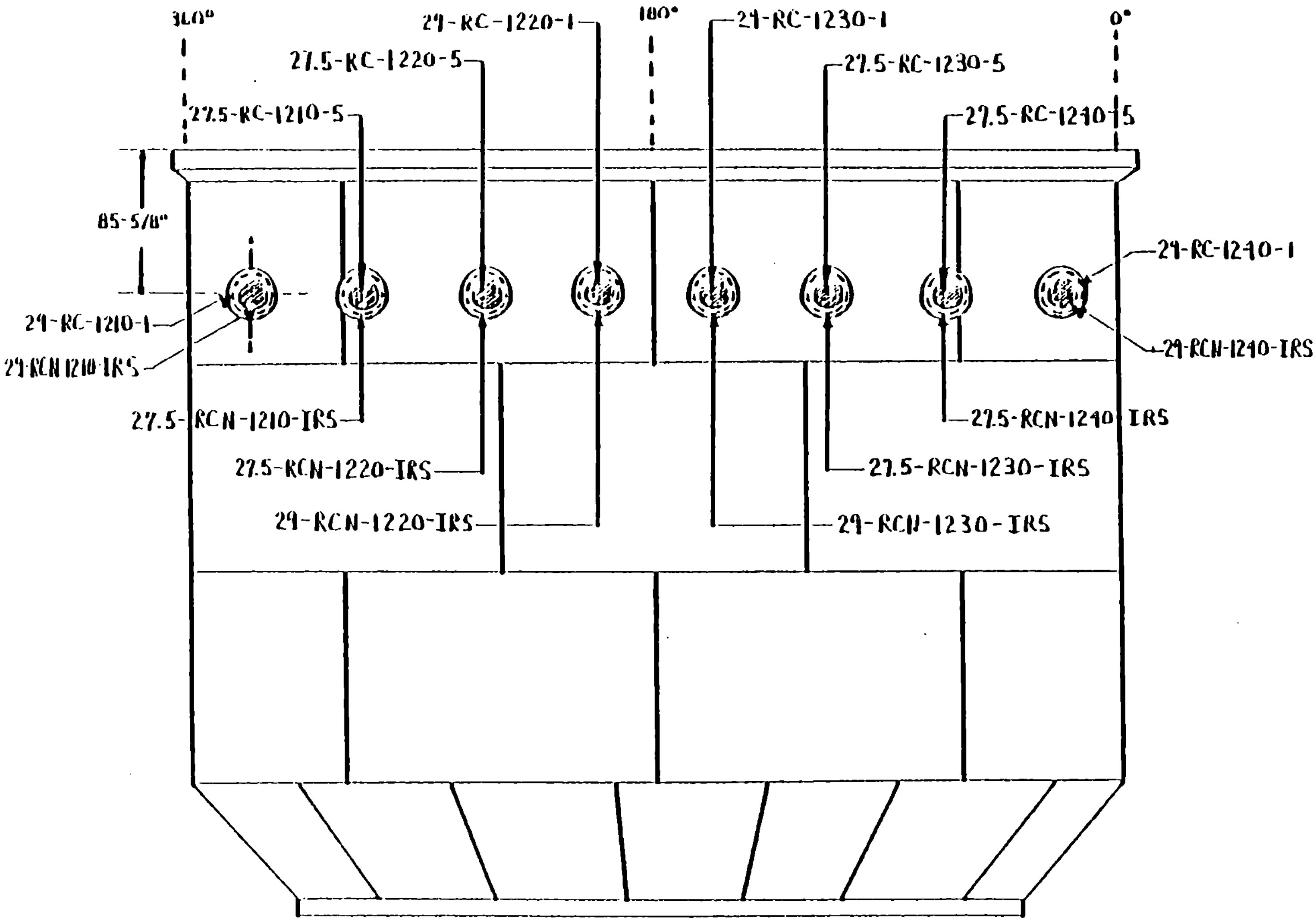
Unique letters (flywheel)
Reactor Coolant Pump
Reactor Coolant Pump No. 21



PSB&G No: Reactor Pressure Vessel	PSB&G Dwg: ___	Thickness: ___
SwRI No: Reactor Pressure Vessel	Basic Cal. Blk.: See Above*	Figure: A-1



REACTOR PRESSURE VESSEL
FIG. A-1A



*IR-CSCL-73-SAM (IRS Sections)
2.312-SS-37-SAM (Nozzle-to-Safe Ends)
PL-CSCL-3.0-76-SAM (Nozzle-to-Safe Ends)

PSB&G No: Reactor Pressure Vessel	PSB&G Dwg: ----	Thickness:--	
SwRI No: Reactor Pressure Vessel	Basic Cal. Blk.: See Above*		Figure: A-2

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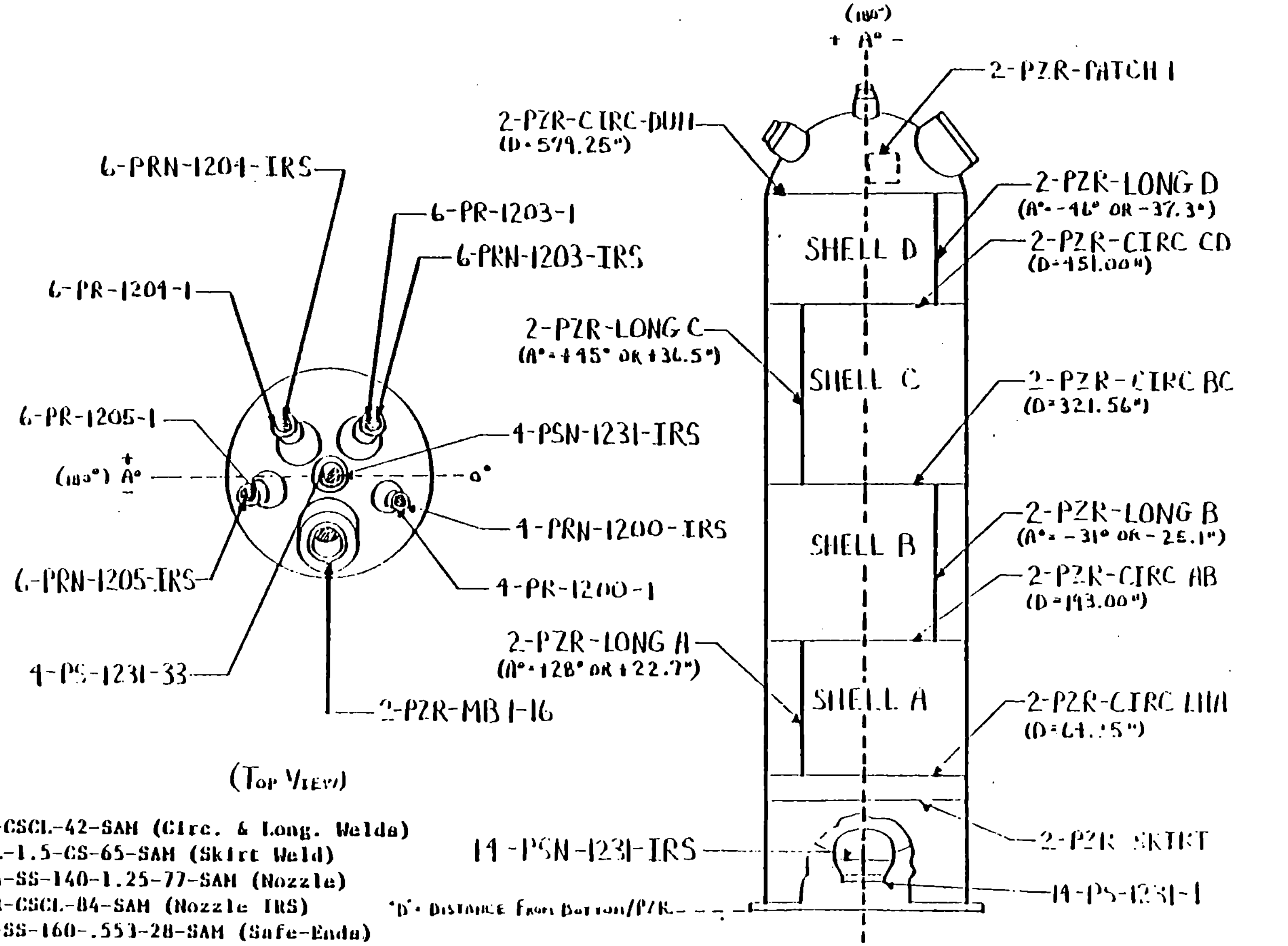
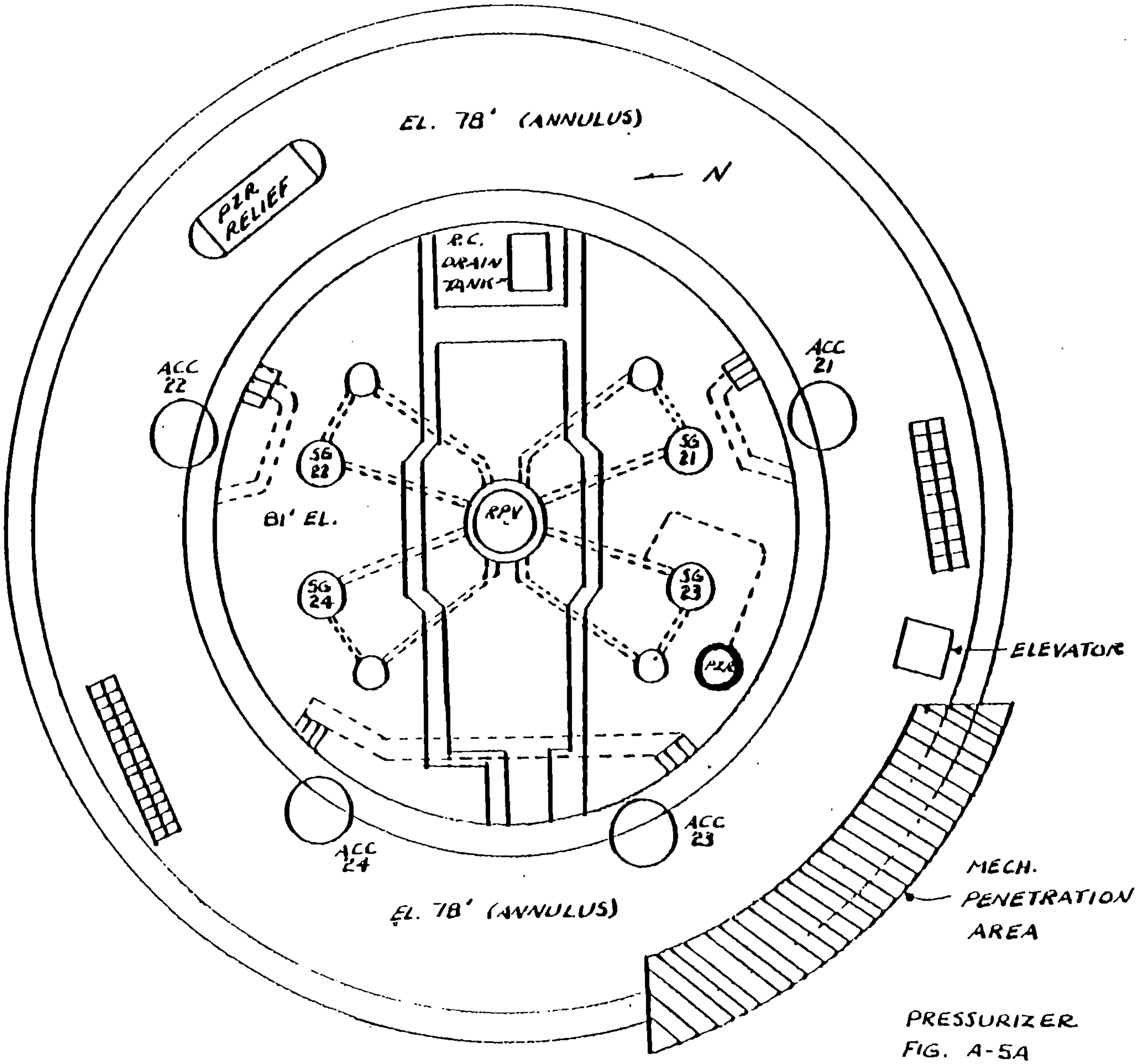
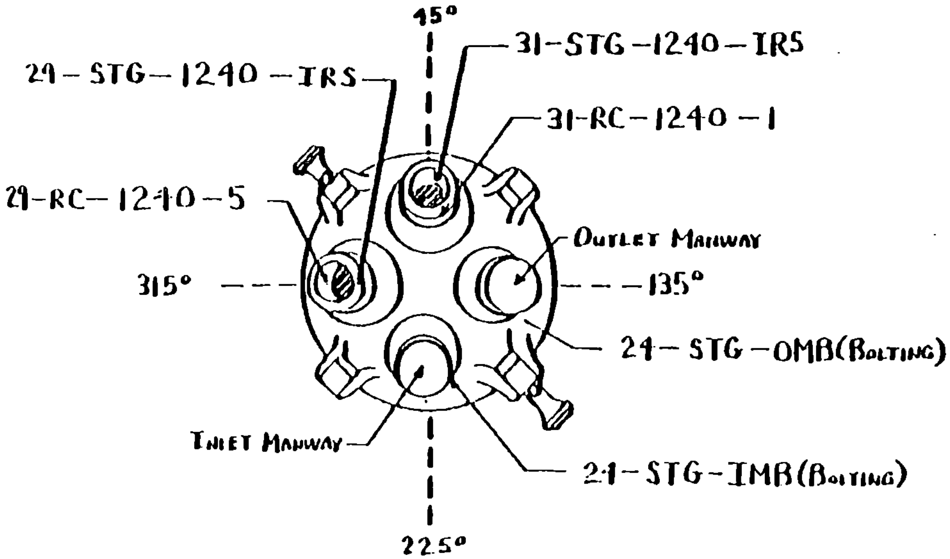


*5-CSCL-42-SAM (Circ. & Long. Welds)
PL-1.5-CS-65-SAM (Skirt Weld)
14-SS-140-1.25-77-SAM (Nozzle)
IR-CSCL-84-SAM (Nozzle IRS)
4-SS-160-.553-28-SAM (Safe-Ends)
4.5-SS-XX-1.0-71-SAM (Safe Ends)
6-SS-XX-1.5-64-SAM (Safe Ends)

PSE&G No: Pressurizer	PSE&G Dwg: Warghse. 4452D51	Thickness: ___
SwRI No: Pressurizer	Basic Cal. Blk.: See Above*	Figure: A-5



PRESSURIZER
FIG. A-5A



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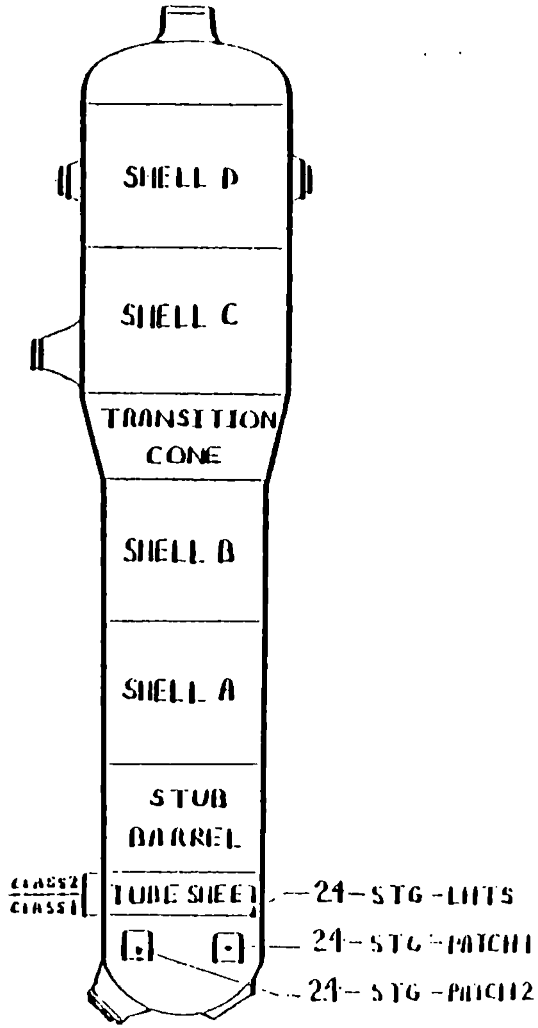
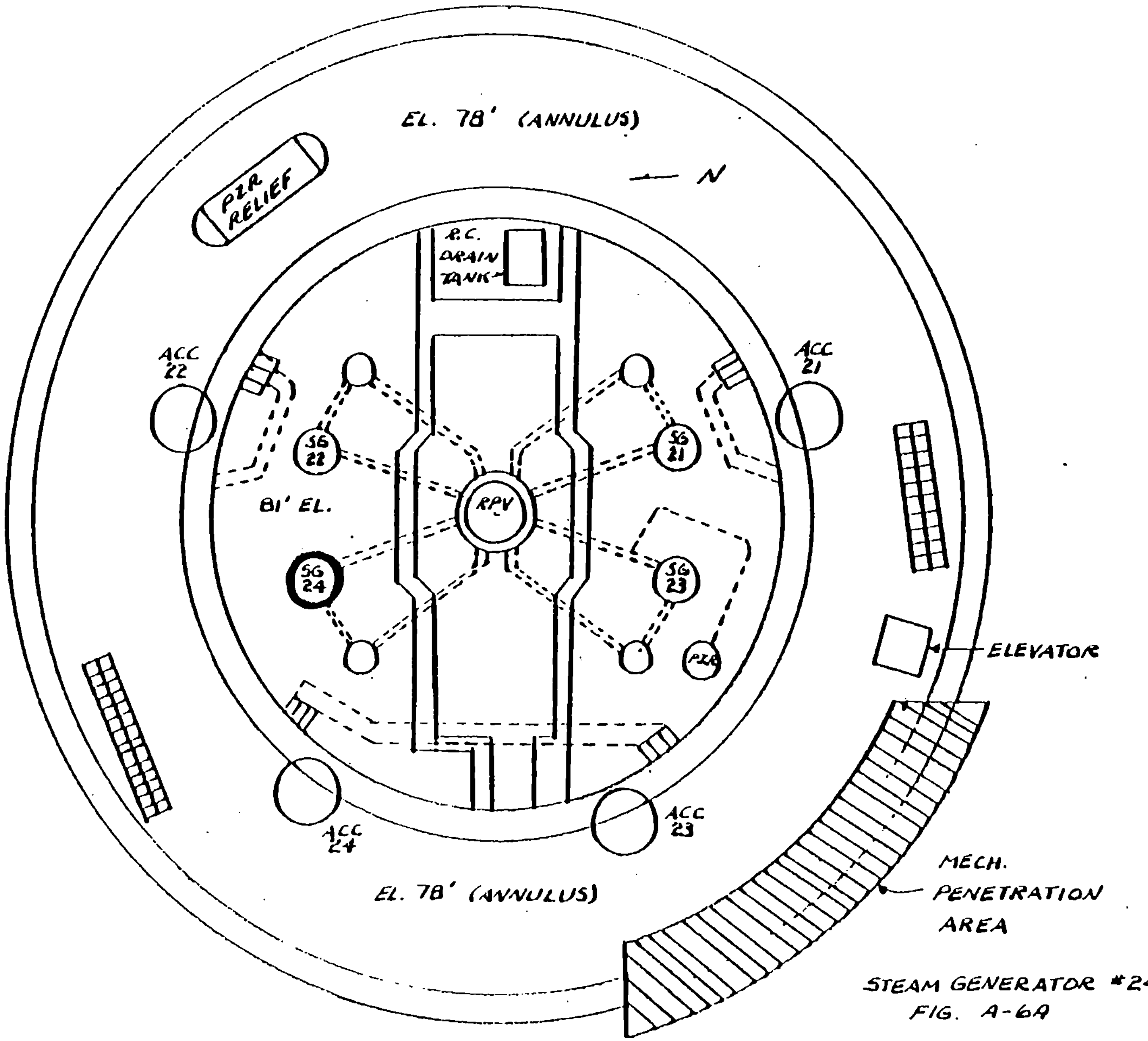
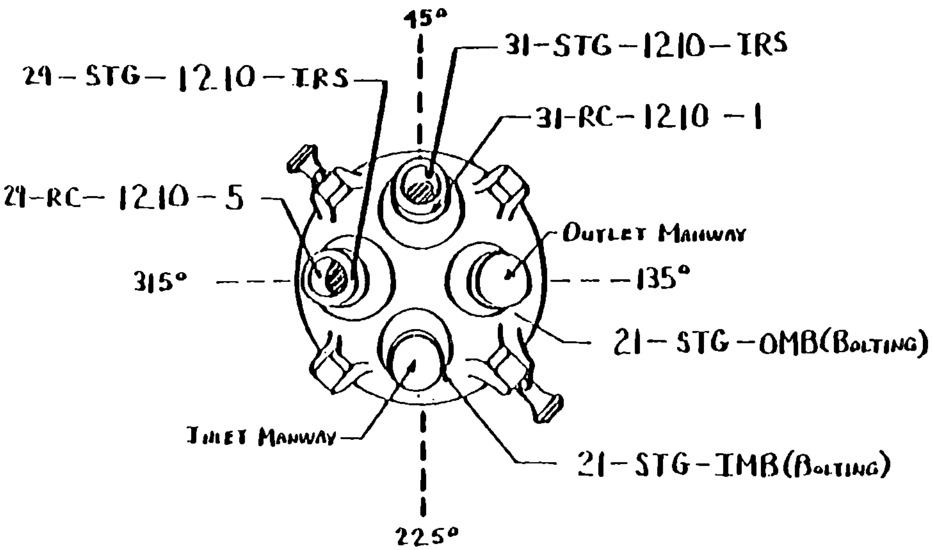


*5-CSCL-42-SAM(Circ. Welds)
1R-CSCL-84-SAM(Inner Radius Section Welds)
7-CSCL-50-SAM(Inner Radius Section Welds)
2.312-SS-37-SAM(Nozzle-to-Safe End Welds)

PSE&G No: Steam Generator #24	PSE&G Dwg: 1098J17 (Watghse., Fla.)	Thickness: ________________
SwRI No: Steam Generator #24	Basic Cal. Blk.: See Above*	Figure: A-6



STEAM GENERATOR #24
FIG. A-6A



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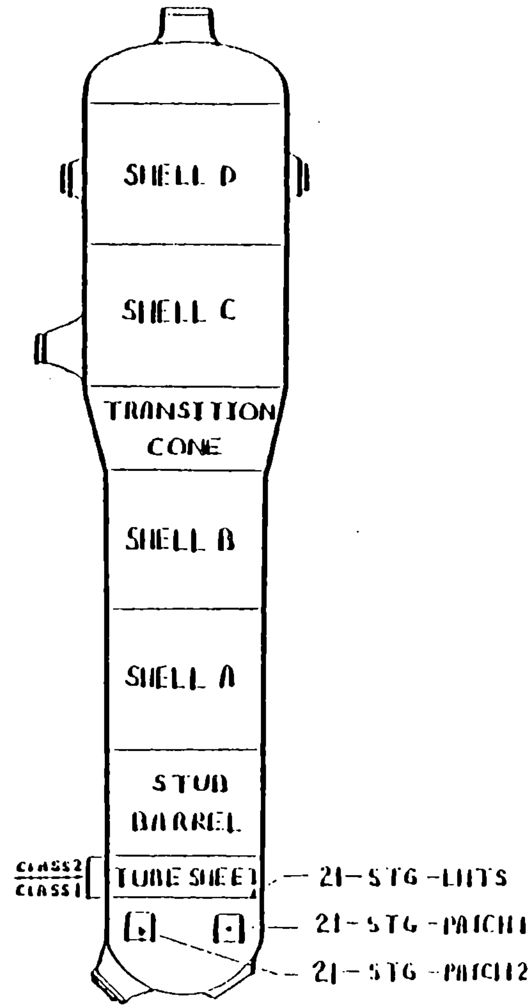
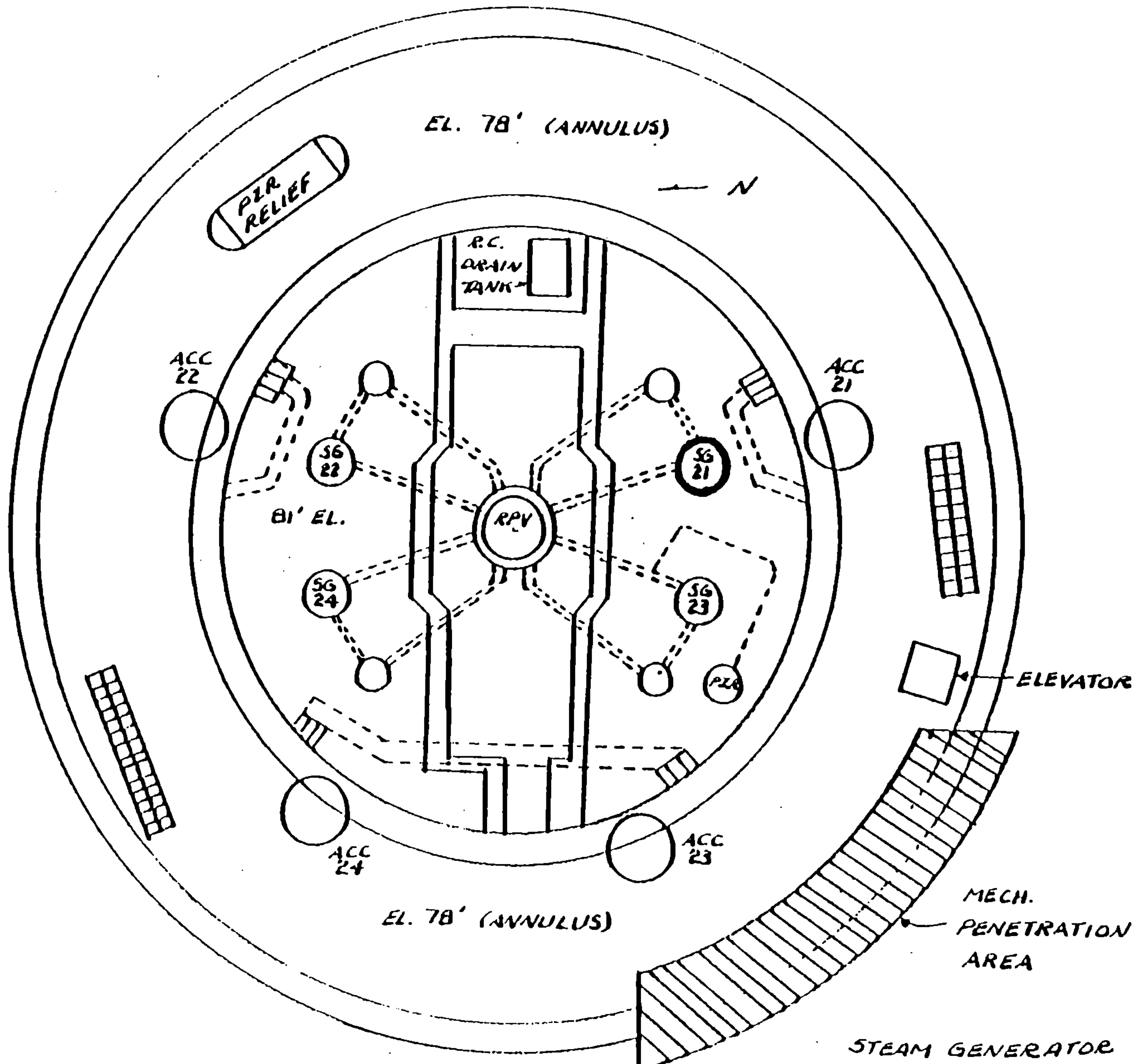
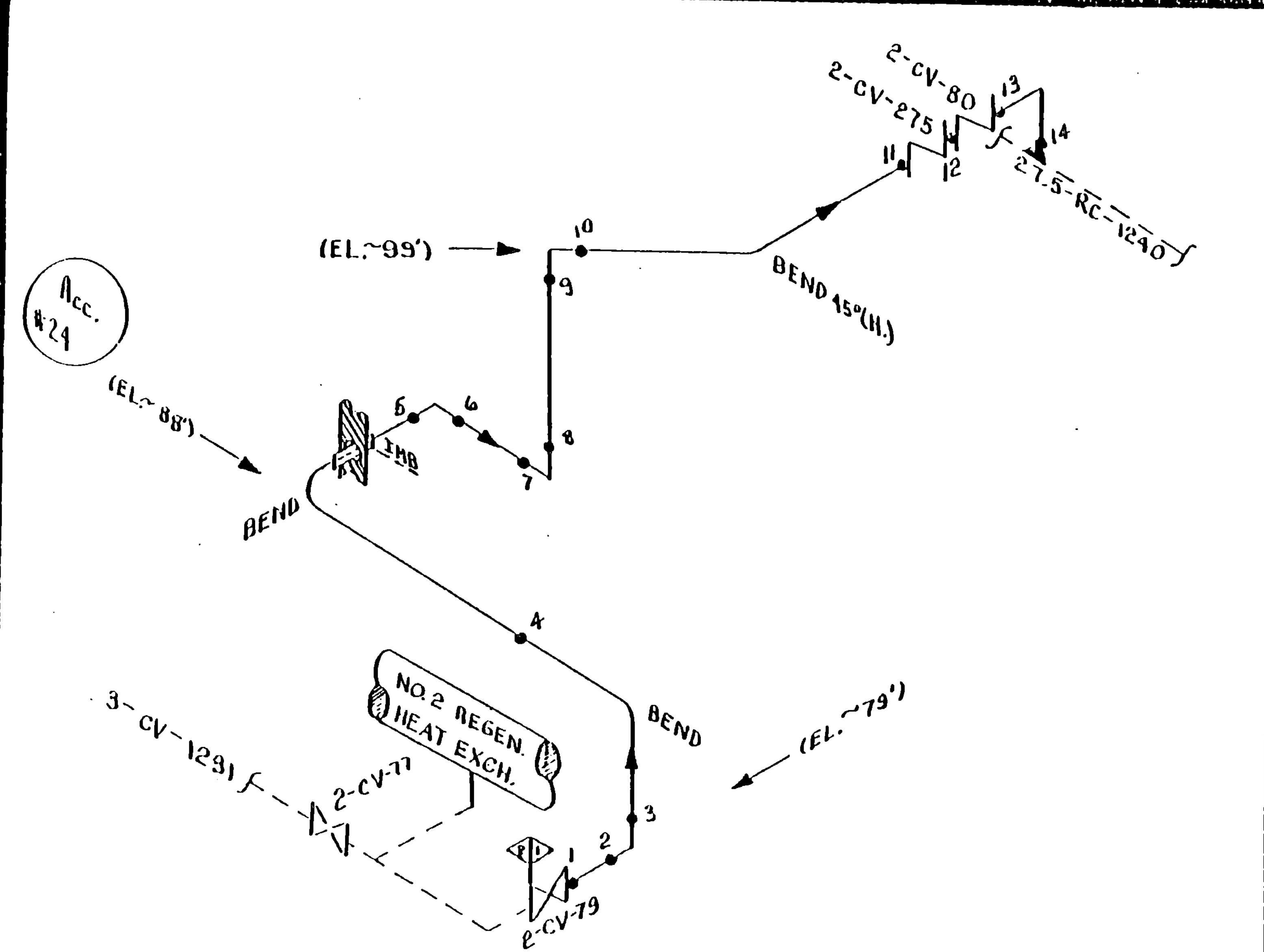


*5-CSCL-42-SAM(Circ. Welds)
1R-CSCL-84-SAM(Inner Radius Section Welds)
7-CSCL-50-SAM(Inner Radius Section Welds)
2.312-SS-37-SAM(Nozzle-to-Safe End Welds)

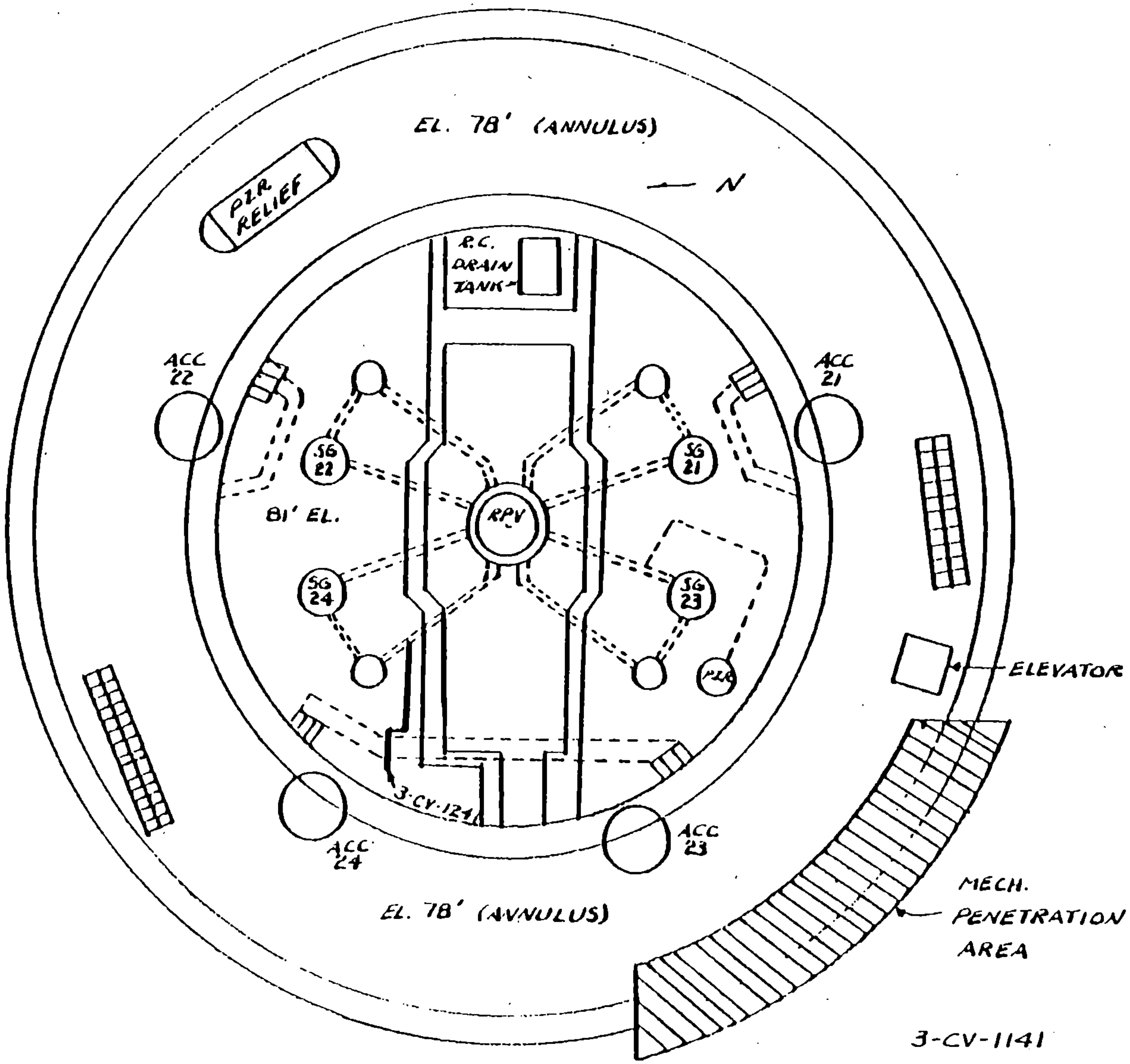
PSI&G No: Steam Generator #21	PSI&G Dwg: 1098117(Watghee., Fla.)	Thickness: ______________
SwRI No: Steam Generator #21	Basic Cal. Blk.: See Above*	Figure: A-9



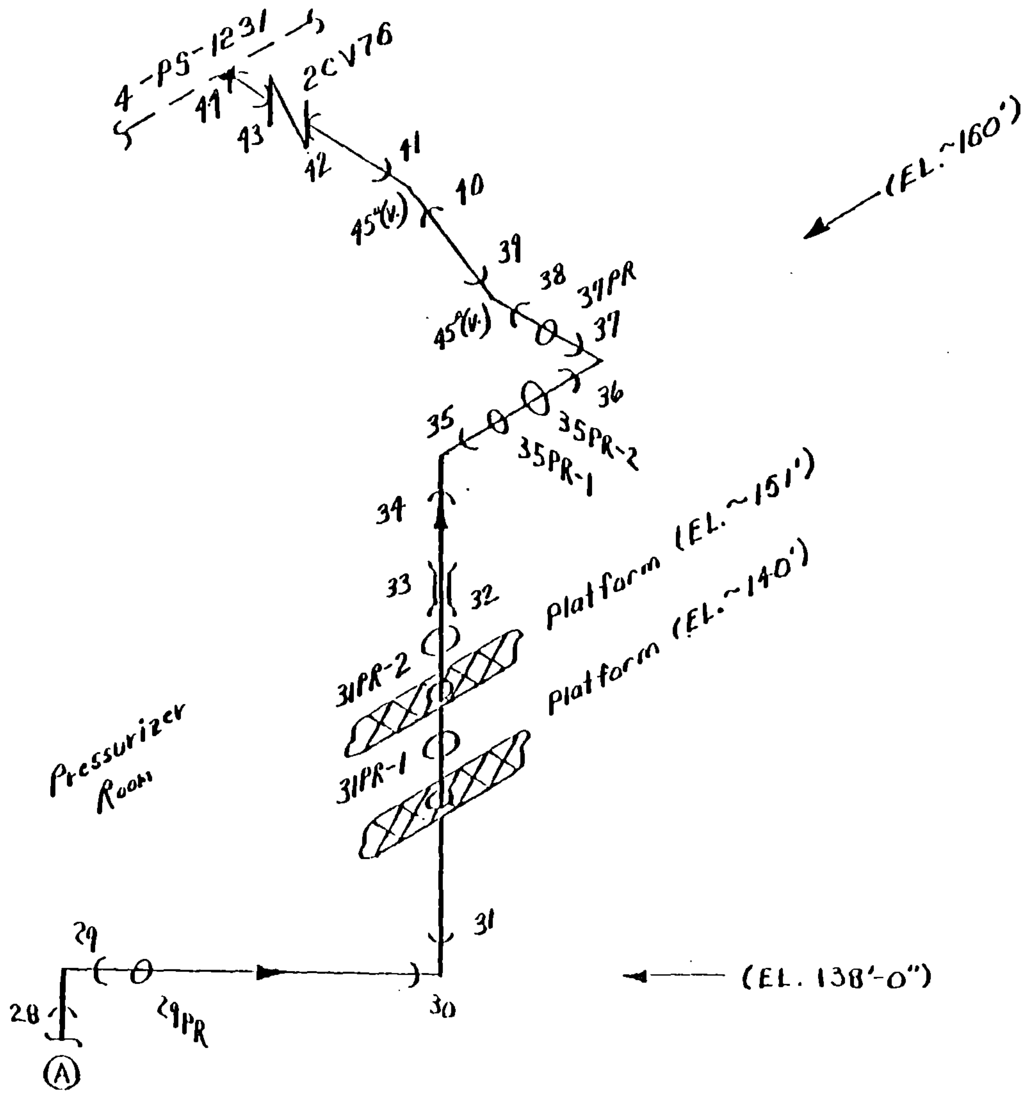
STEAM GENERATOR #21
FIG. A-9A



PSE&G No: 3"-2CV1000	PSE&G Dwg: CV-2-3 Sht. 2	Thickness: 0.438"	
SwRI No: 3-CV-1241	Basic Cal. Blk.: 3-SS-160-.451-30-SAM		Figure: A-12



3-CV-1141
FIG. A-12A



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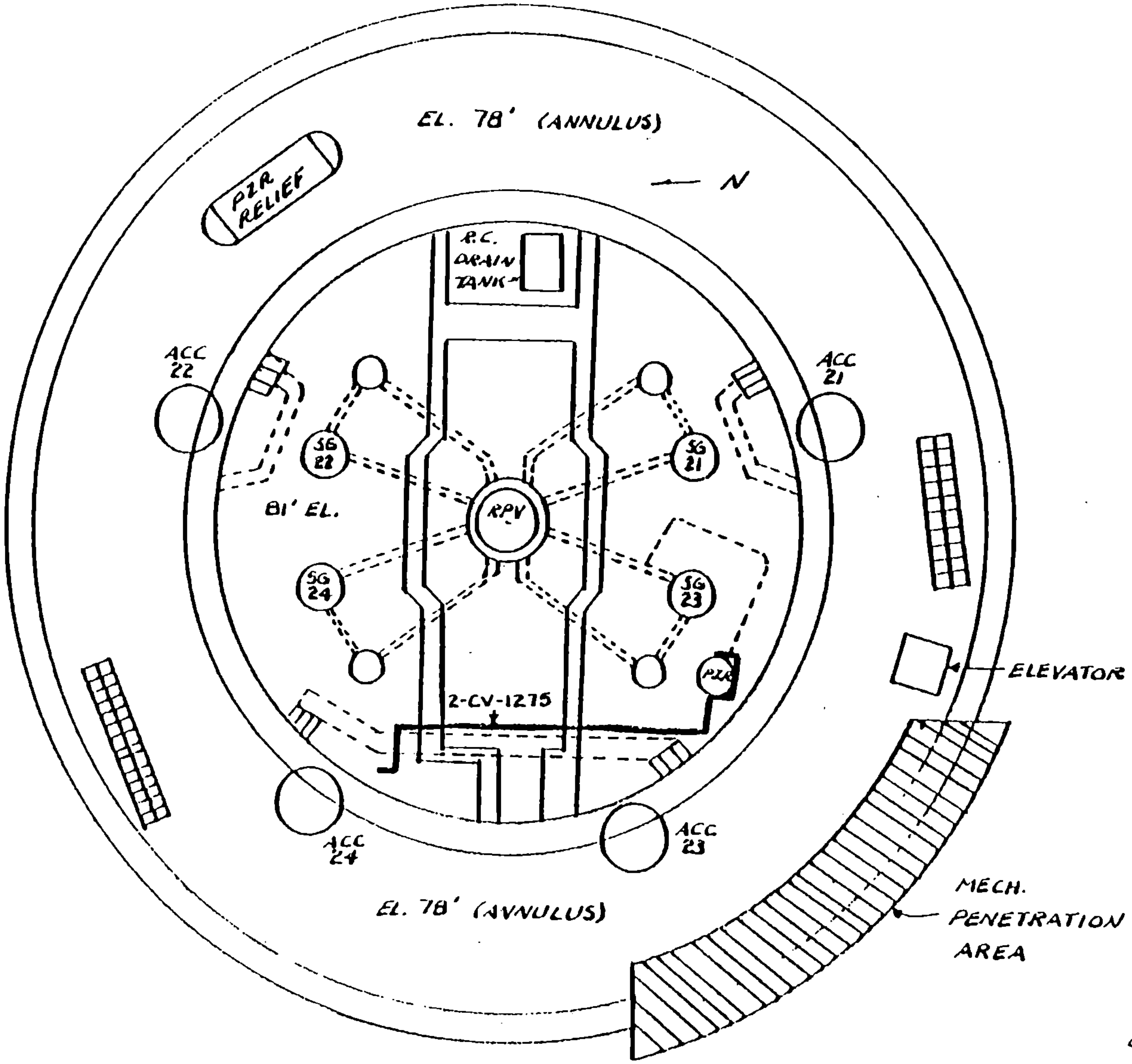
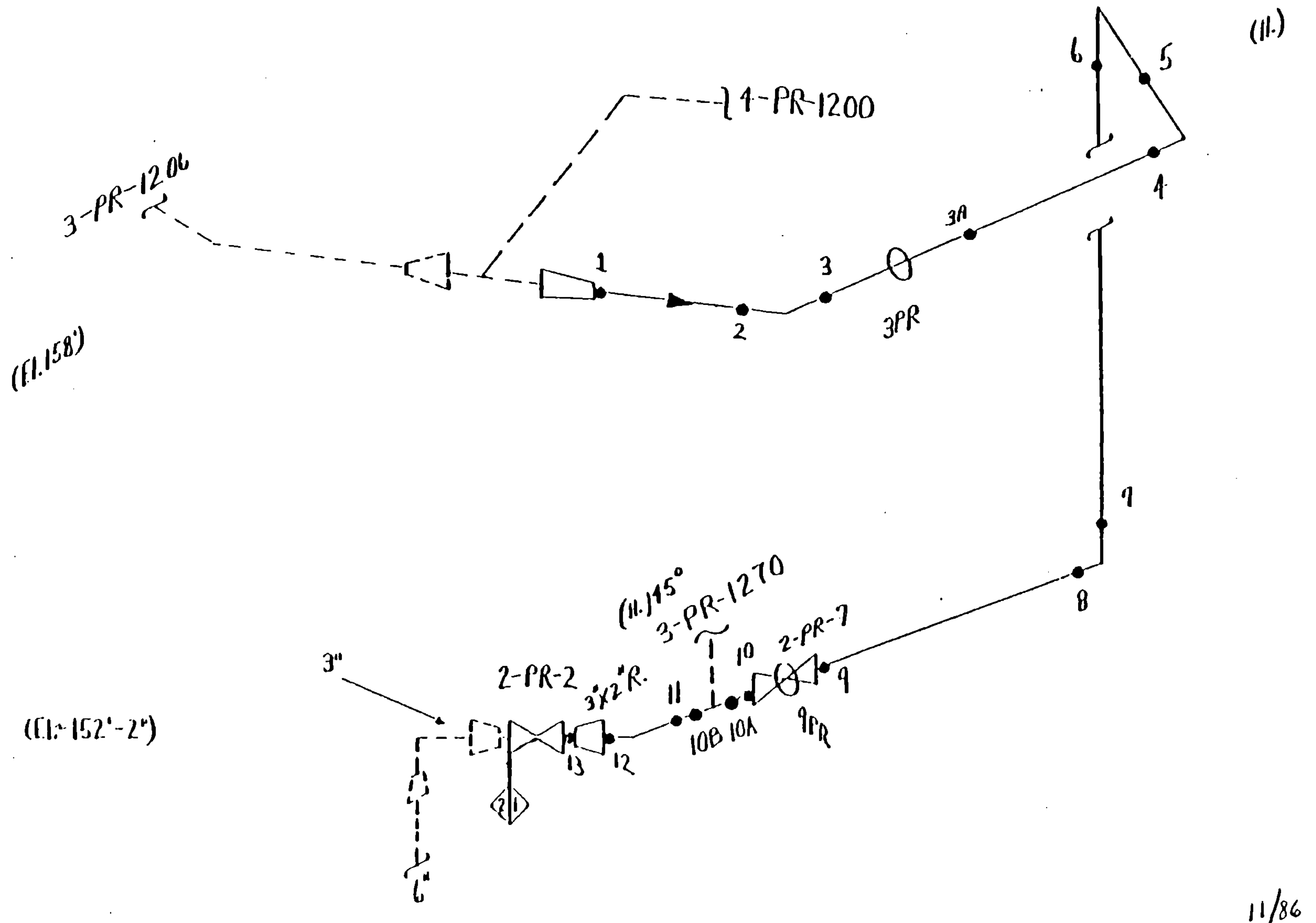
PSE&G No: 2"-2CV1156	PSE&G Dwg: RC-2-3 Sht. 13	Thickness: 0.344"
SwRI No: 2-CV-1275	Basic Cal. Blk.: N/A	Figure: A-16



2-CV-1275
FIG. A-16A



PSE&G No: 3"2PS1028	PSE&G Dwg: RC-2-3 Sht. 5	Thickness: .438"
SwRI No: 3-PR-1207	Basic Cal. Blk.: 3-SS-160-.451-30-SAM	Figure: A-23

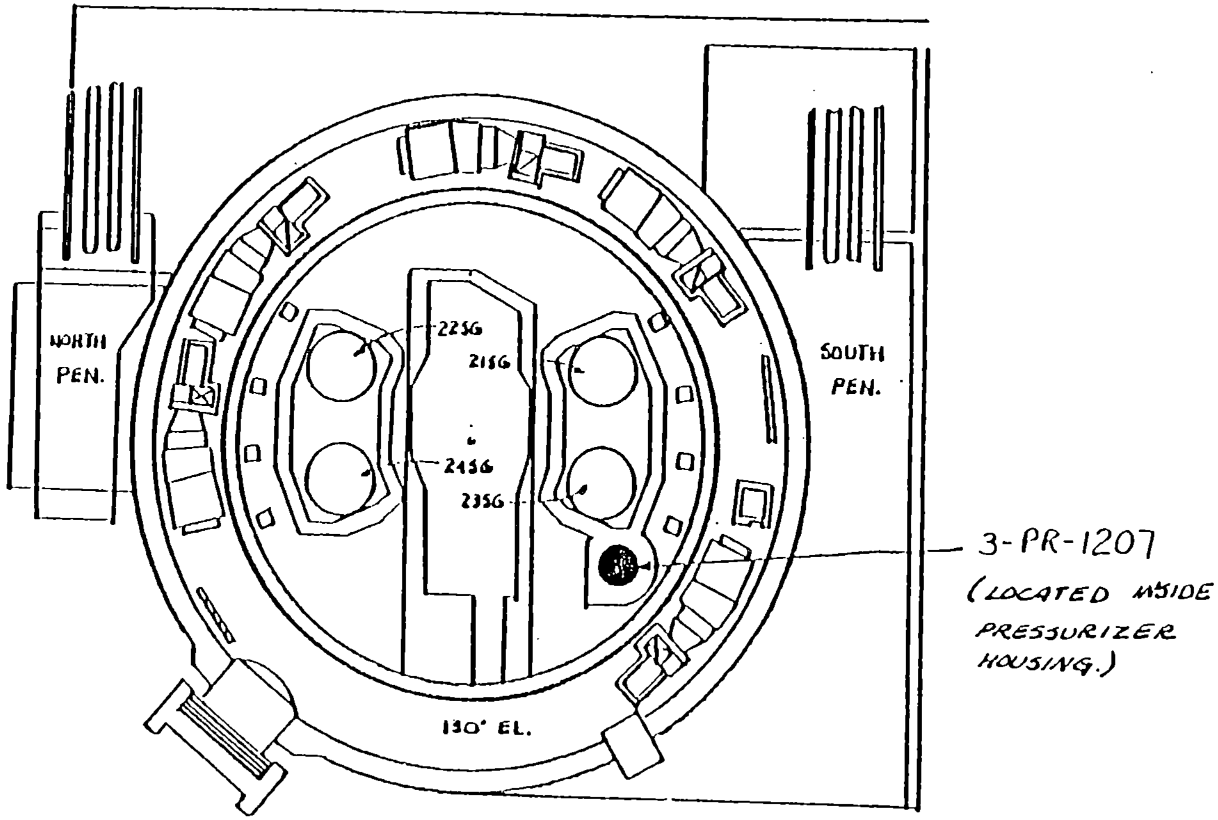
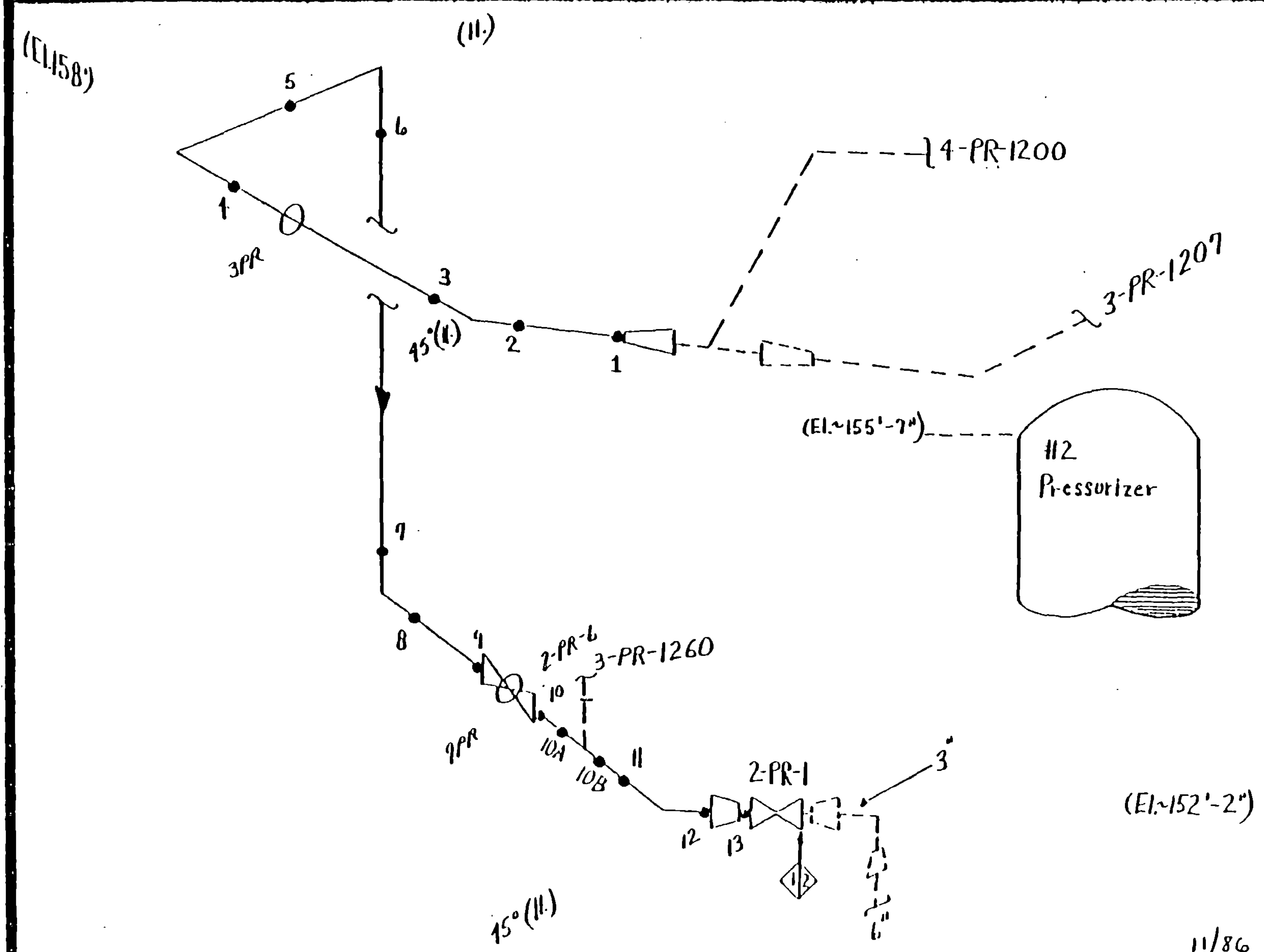

NORTH PEN.
SOUTH PEN.
22SG
21SG
24SG
23SG
130' EL.
3-PR-1207
(LOCATED INSIDE PRESSURIZER HOUSING.)

FIG. A-23A



PSE&G No: 3"-2PS1027	PSE&G Dwg: RC-2-3 Sht. 5	Thickness: .438"
SwRI No: 3-PR-1206	Basic Cal. Blk.: 3-SS-160-.451-30-SAM	Figure: A-24

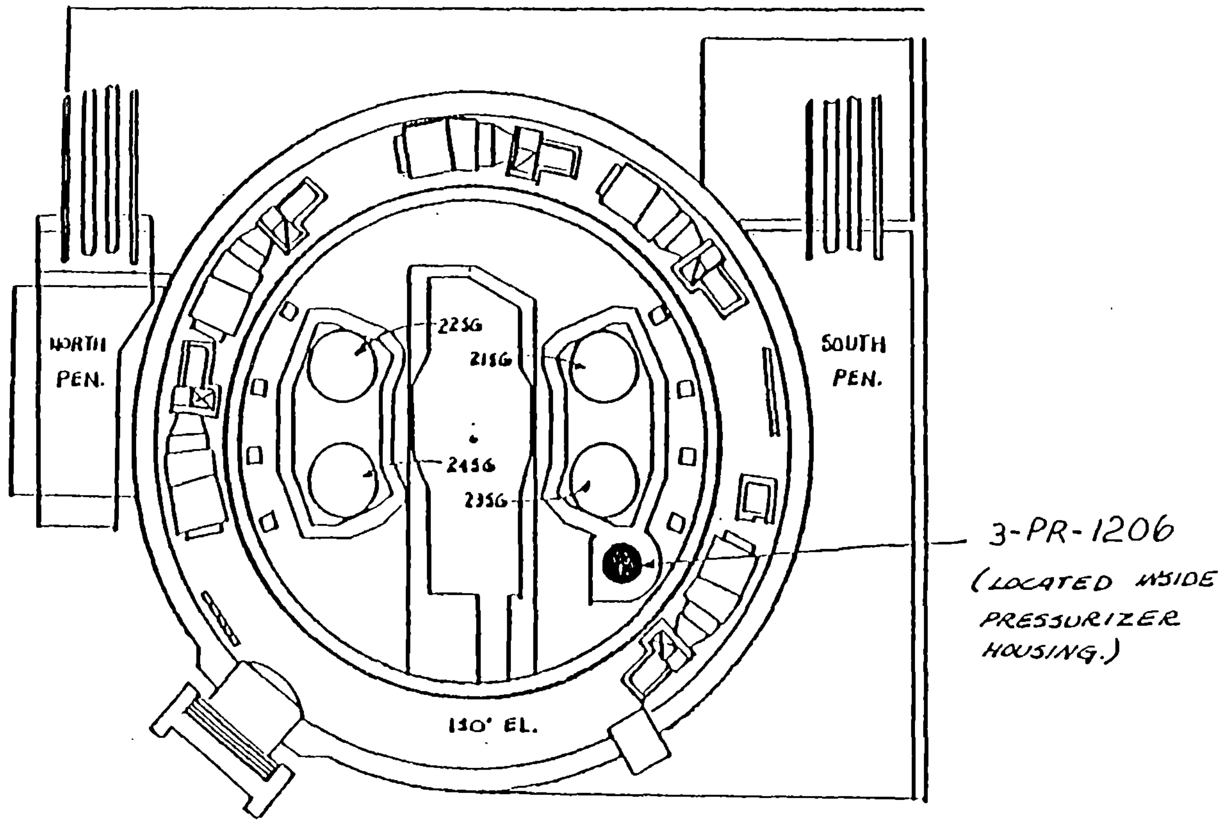
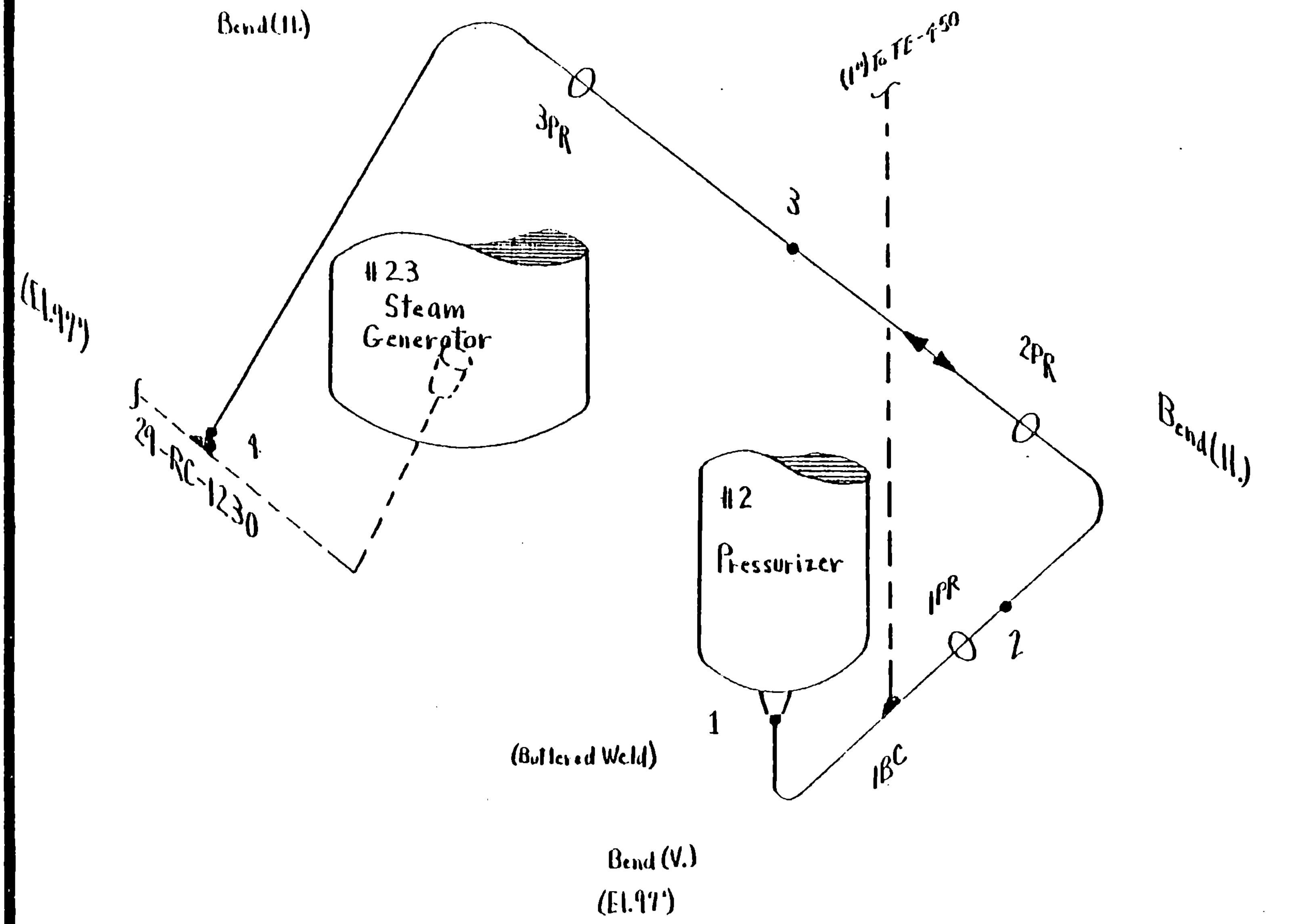
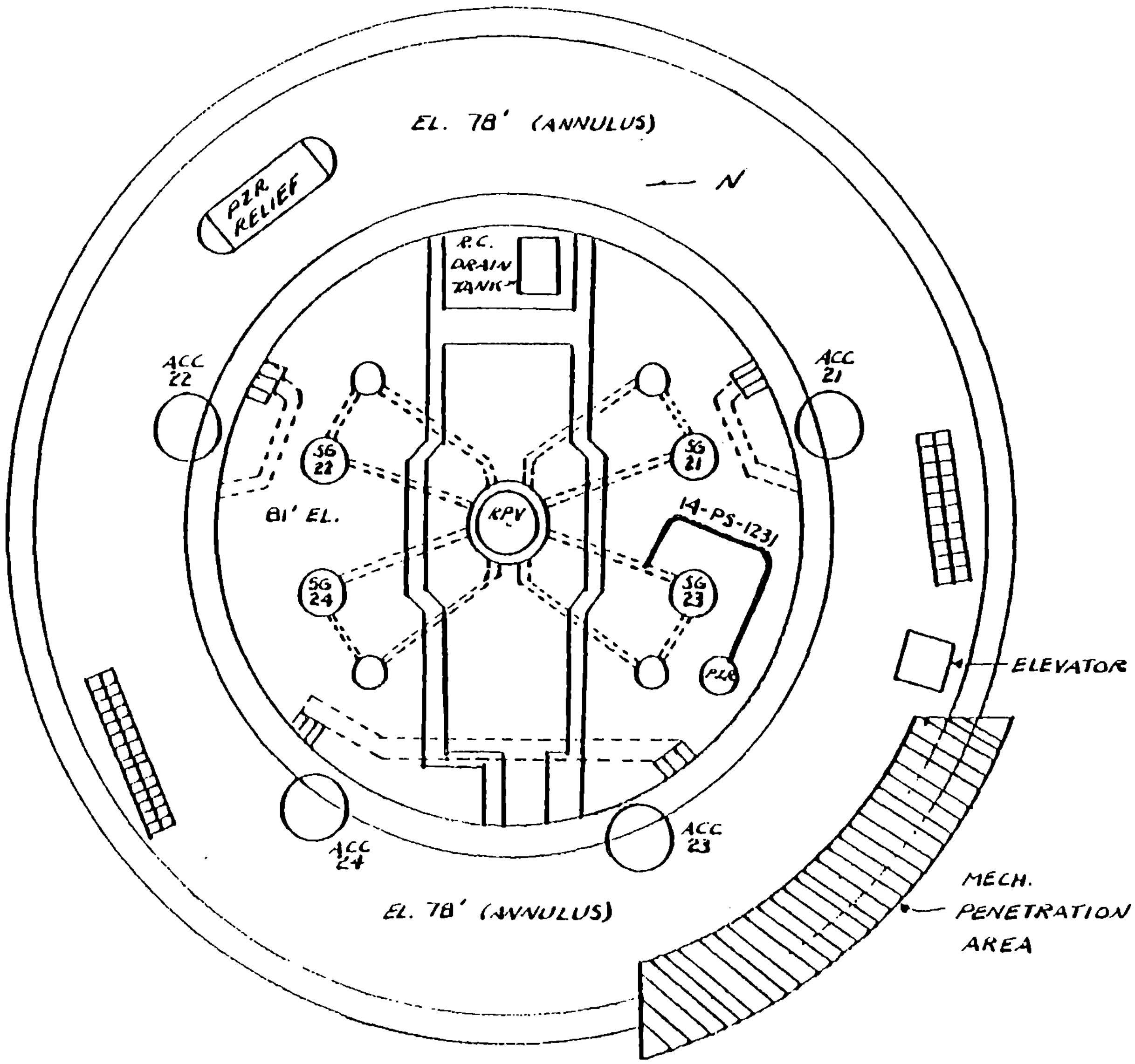

NORTH PEN.
SOUTH PEN.
22SG
21SG
24SG
23SG
130' EL.
3-PR-1206
(LOCATED INSIDE PRESSURIZER HOUSING.)

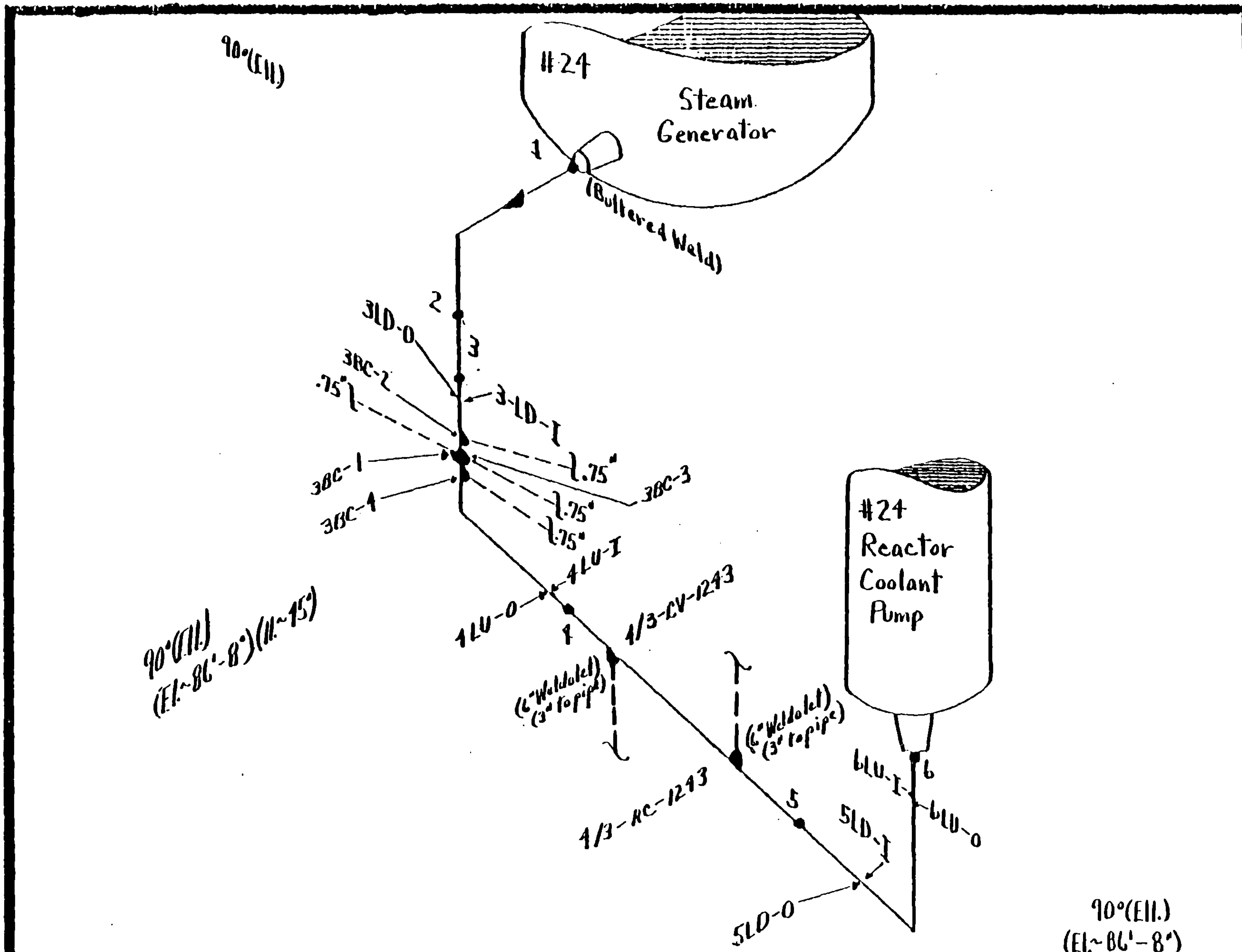
FIG. A-24A



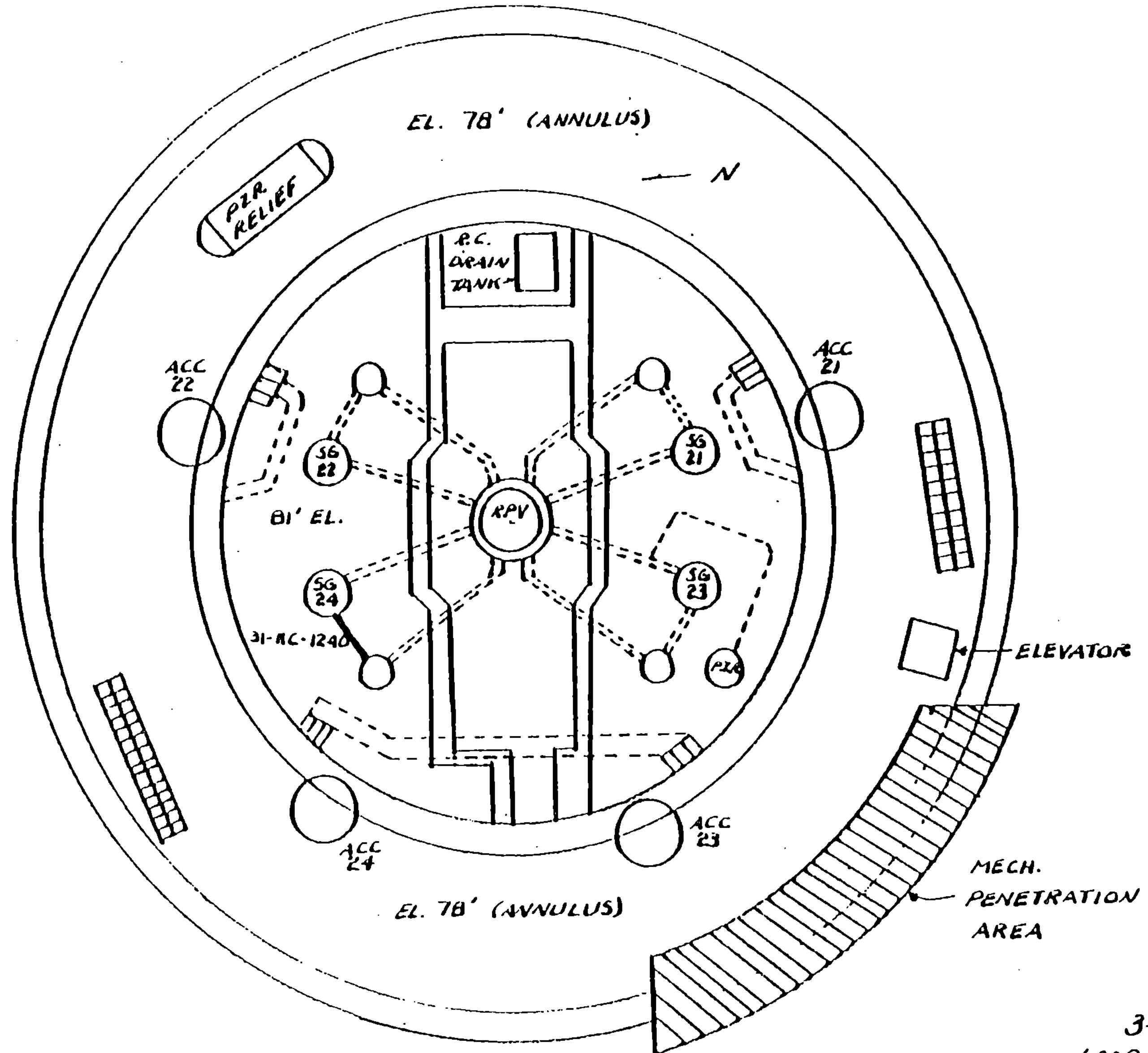
PSE&G No: 14"-2PS1016	PSE&G Dwg: RC-2-3 Sht. 2	Thickness: 1.250"
SwRI No: 14-PS-1231	Basic Cal. Blk.: 14-SS-140-1.25-77-SAM	Figure: A-25



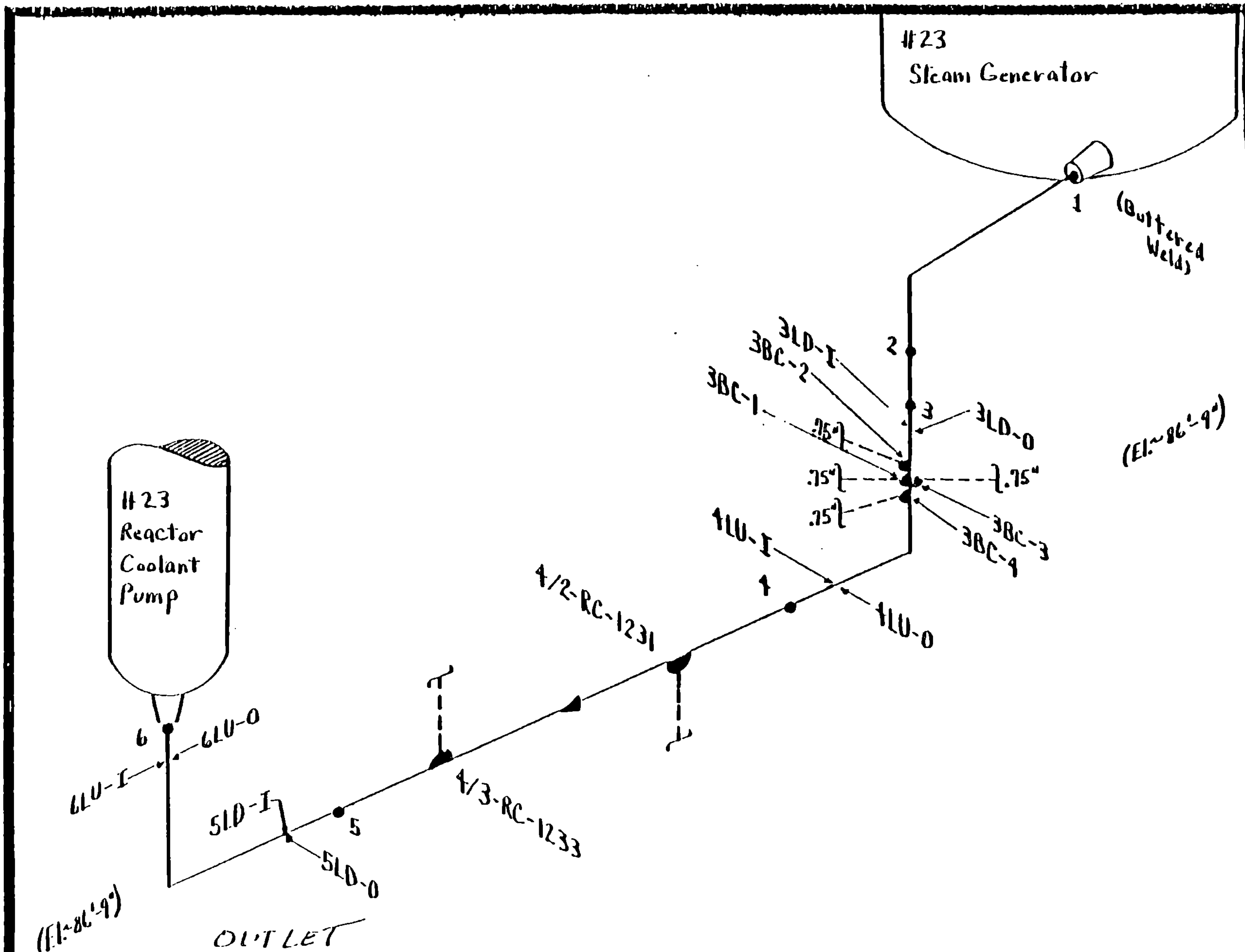
14-PS-1231
FIG. A-25A



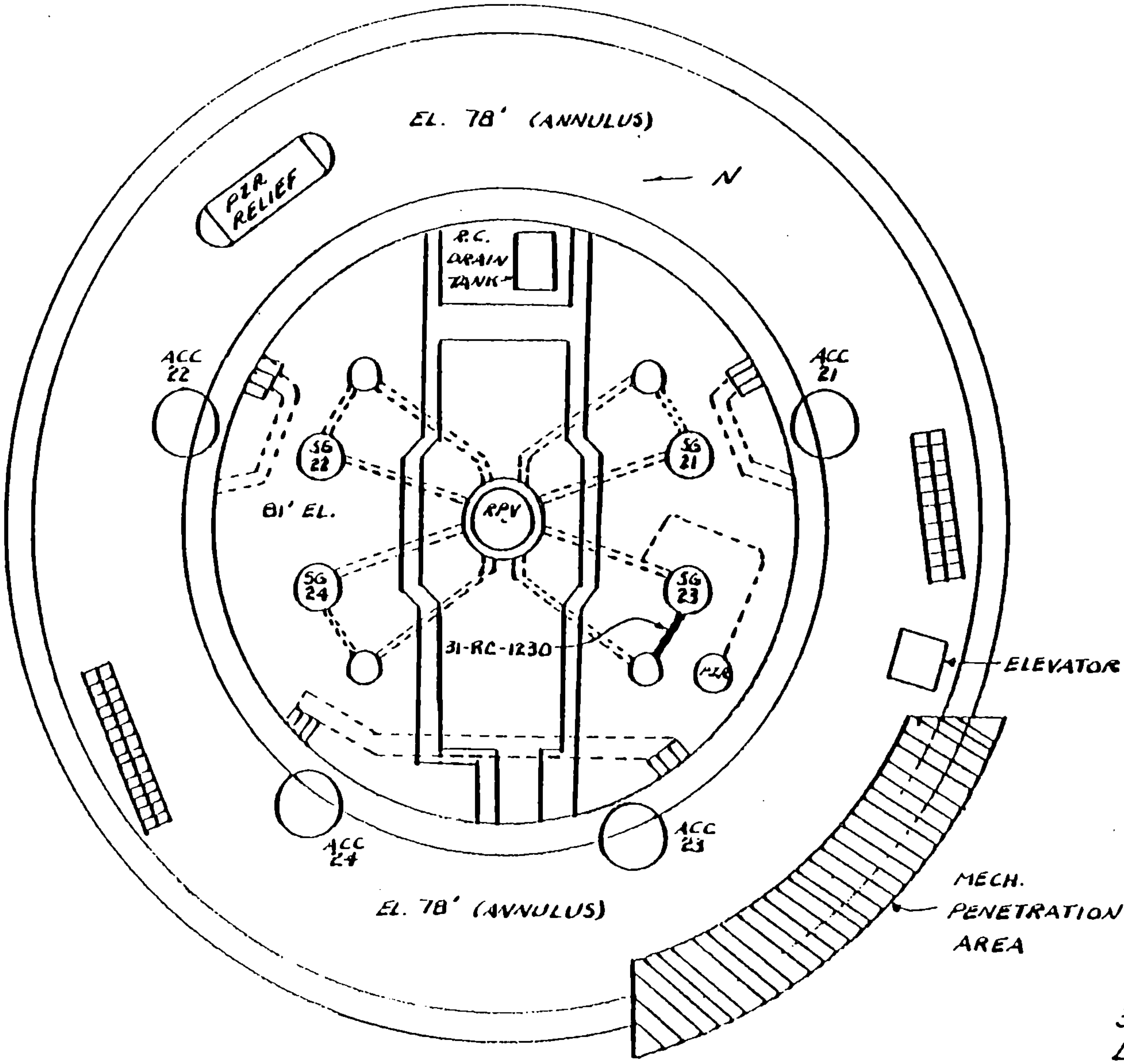
PSBRG No: 31"-2RC1010	PSBRG Dwg: RC-2-3 Sht. 2	Thickness: 2.495" Min. Wall
SwRI No: 31-RC-1240	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-29



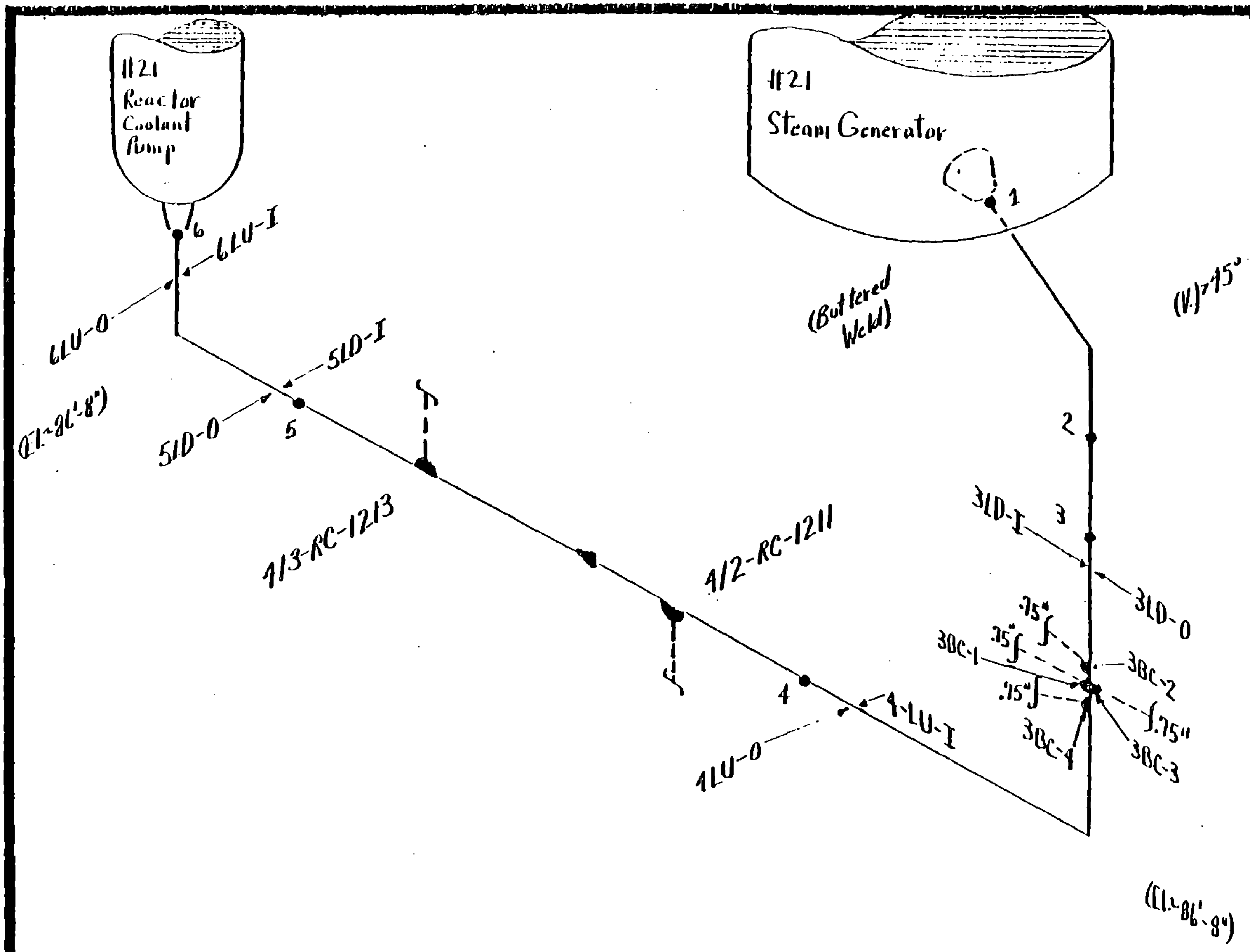
3-RC-1240
LOOP #24 CROSSOVER
FIG. A-29A



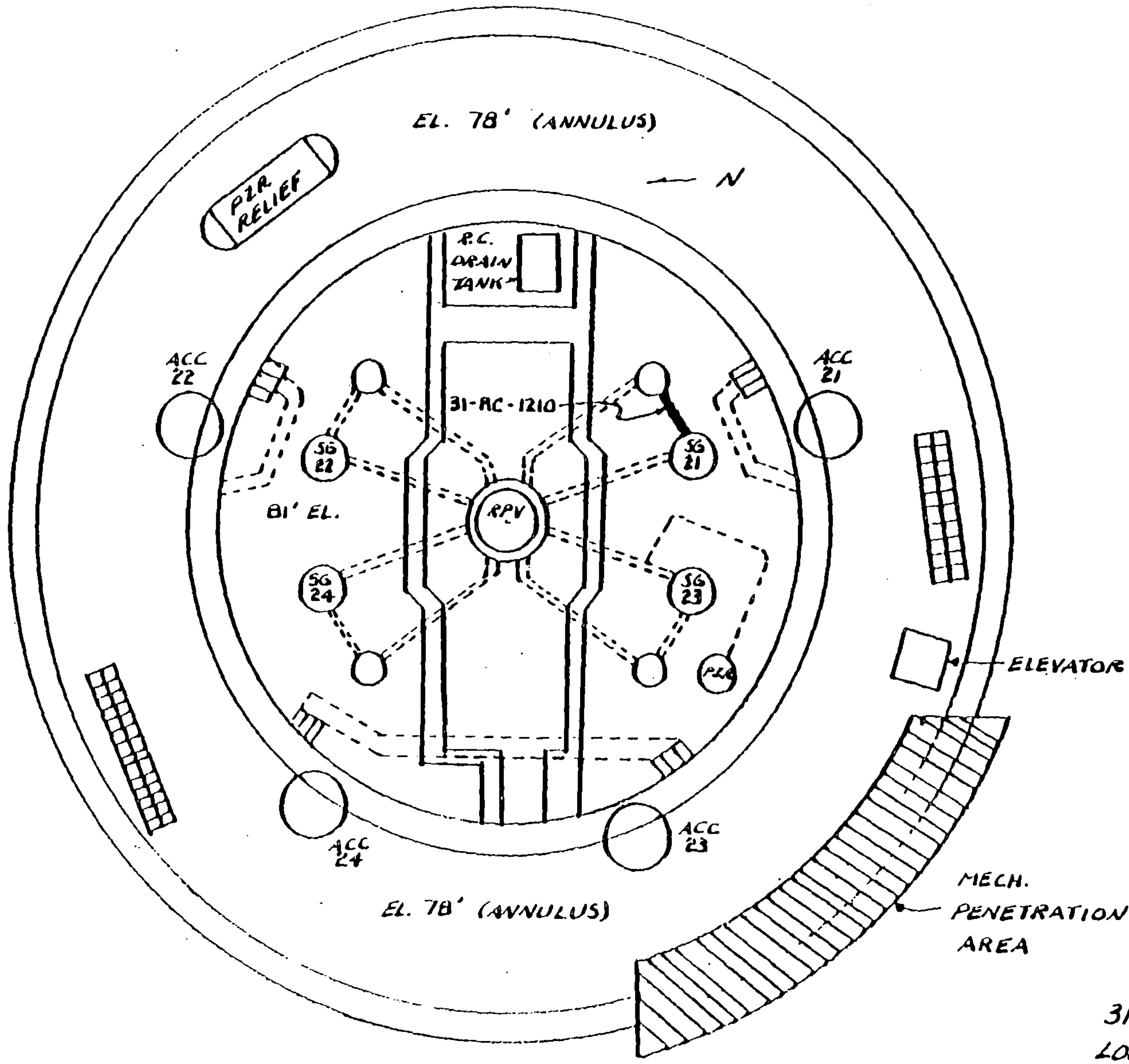
PSE&G No: 31"-2RC1007	PSE&G Dwg: RC-2-3 Sht. 2	Thickness: 2.495" Min. Wall
SwRI No: 31-RC-1230	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-30



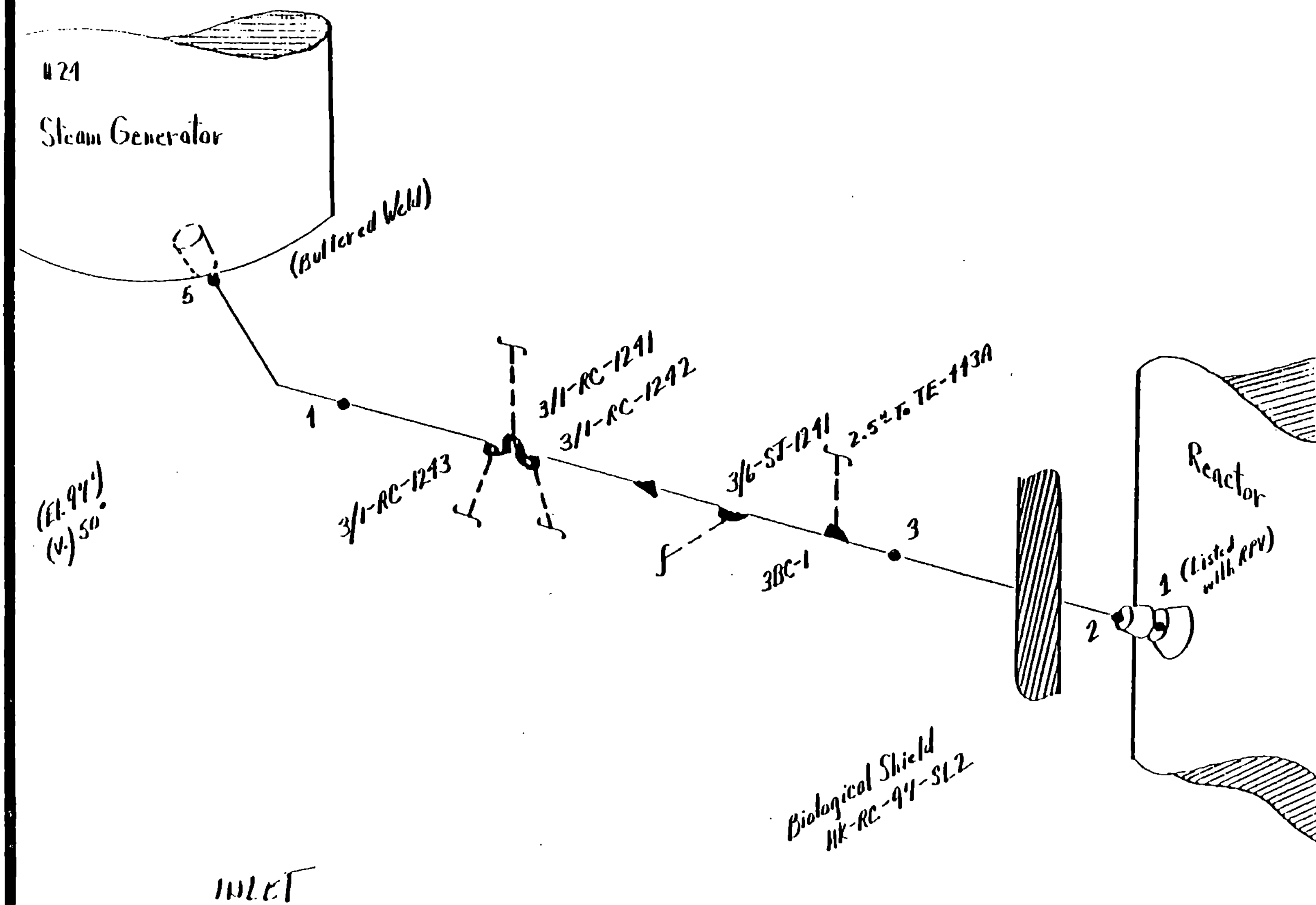
31-RC-1230
LOOP #23 CROSSOVER
FIG. A-30A



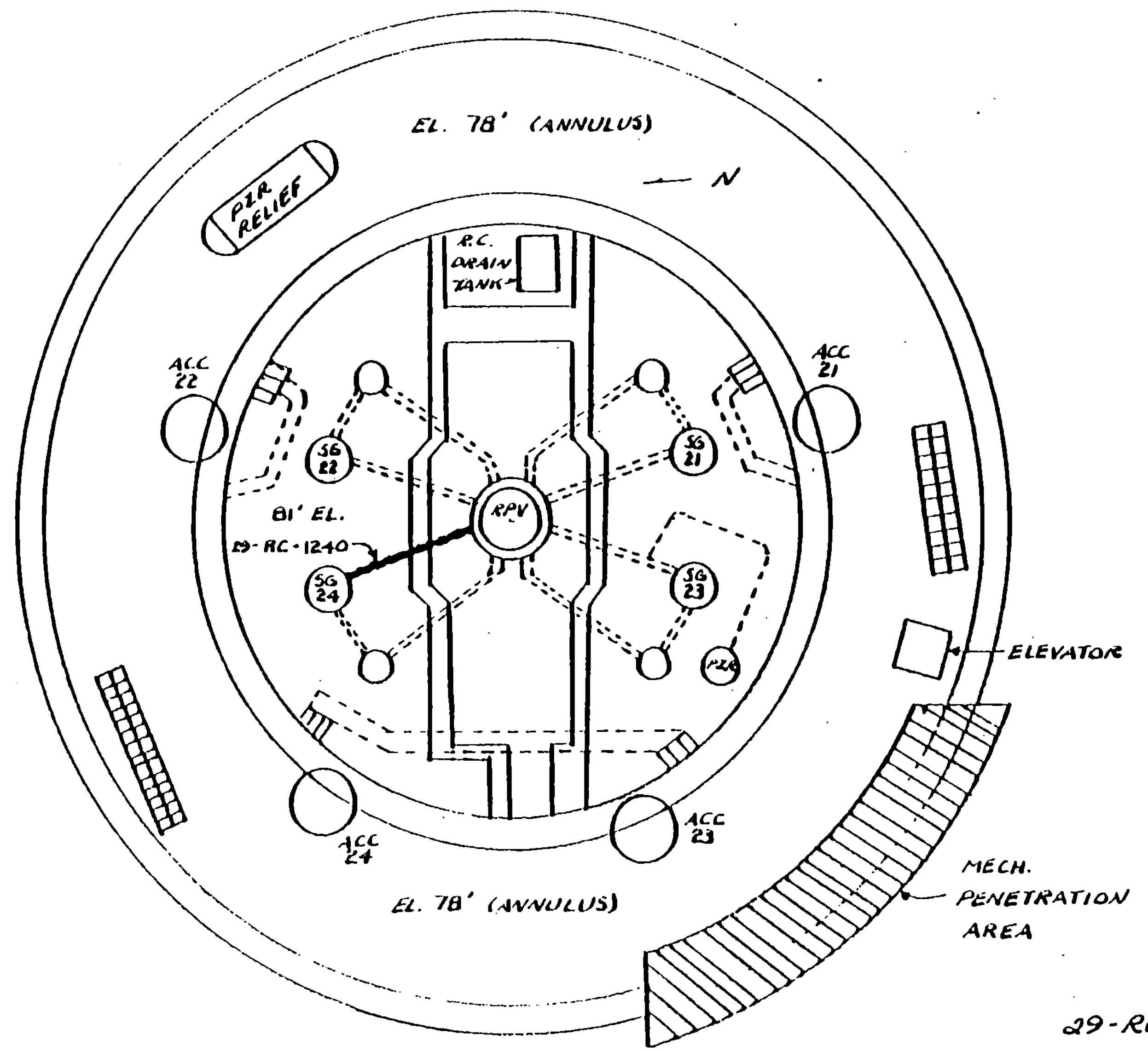
PSE&G No: 31"-2RC1001	PSE&G Dwg: RC-2-3 Sht. 1	Thickness: 2.495" Min. Wall
SwRI No: 31-RC-1210	Basic Cal. Blk. 2.312-SS-37-SAM (plate)	Figure: A-32



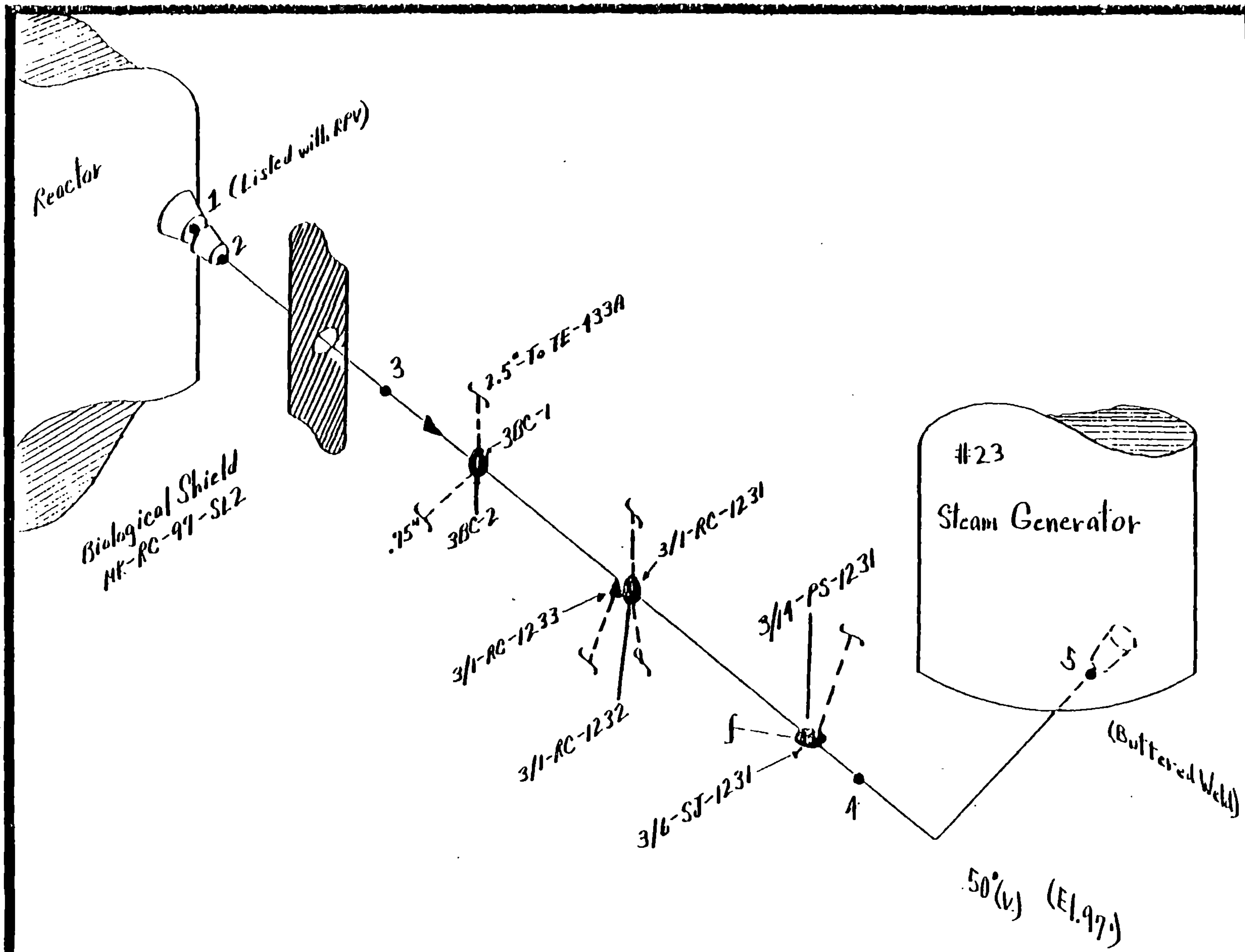
31-RC-1210
LOOP #21 CROSSOVER
FIG. A-32A



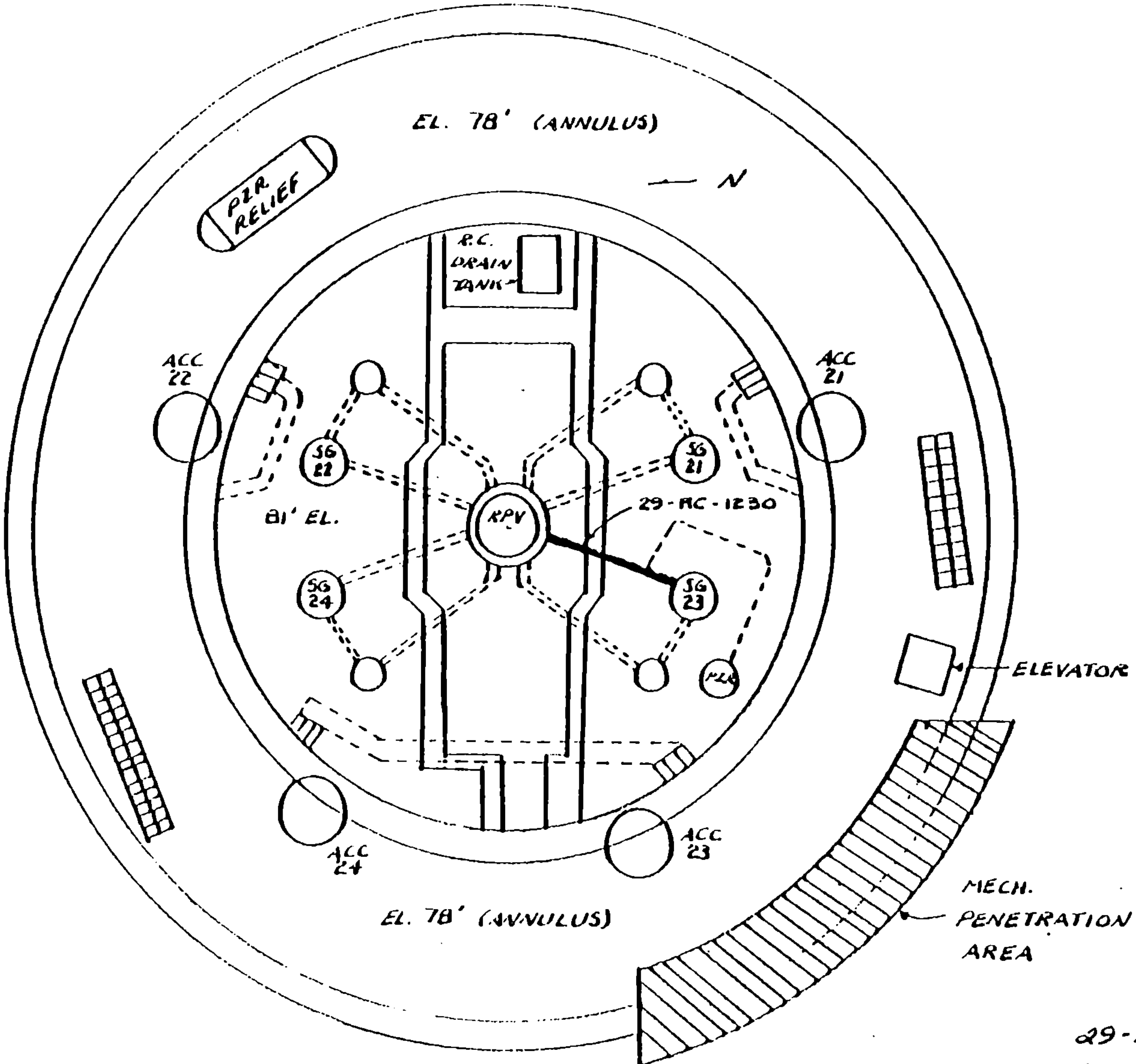
PSRAG No: 29"-2RC1009	PSRAG Dwg: RC-2-3 Sht. 2	Thickness: 2.335" Min. Wall
SwRI No: 29-RC-1240	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-33



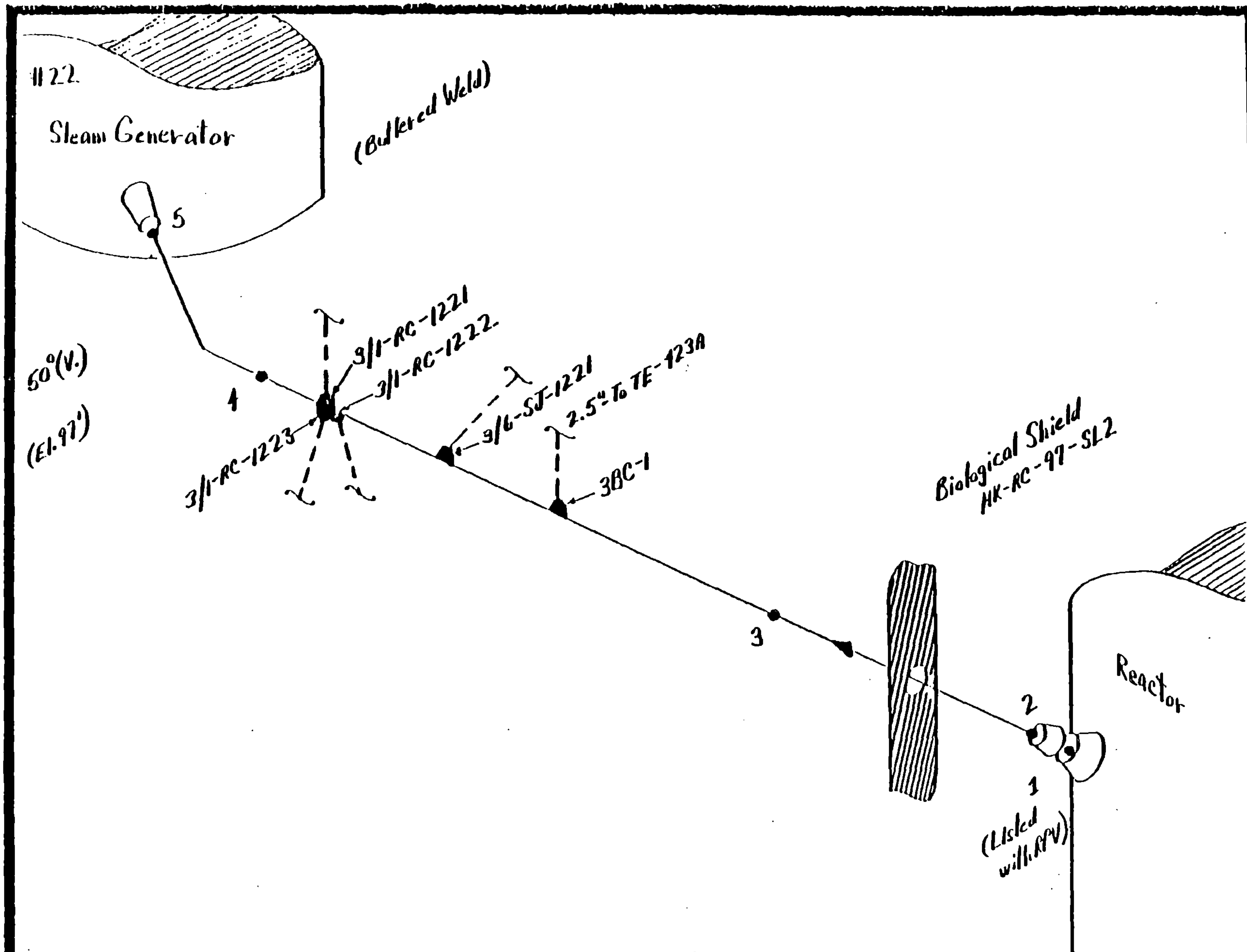
29-RC-1240
LOOP #24 HOT LEG
FIG. A-33A



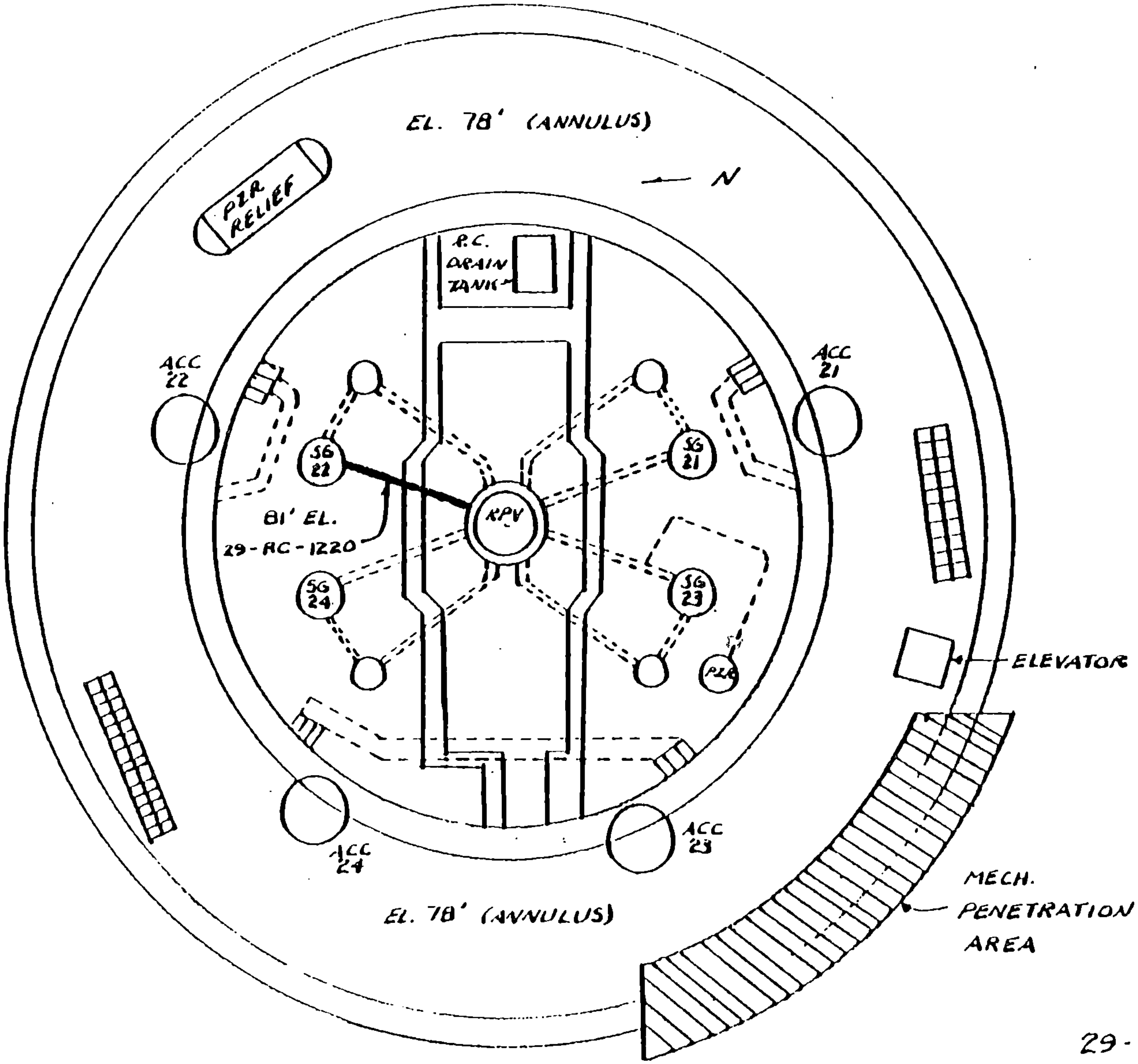
PSE&G No: 29"-2RC1006	PSE&G Dwg: RC-2-3 Sht. 2	Thickness: 2.335" Min. Wall
SwRI No: 29-RC-1230	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-34



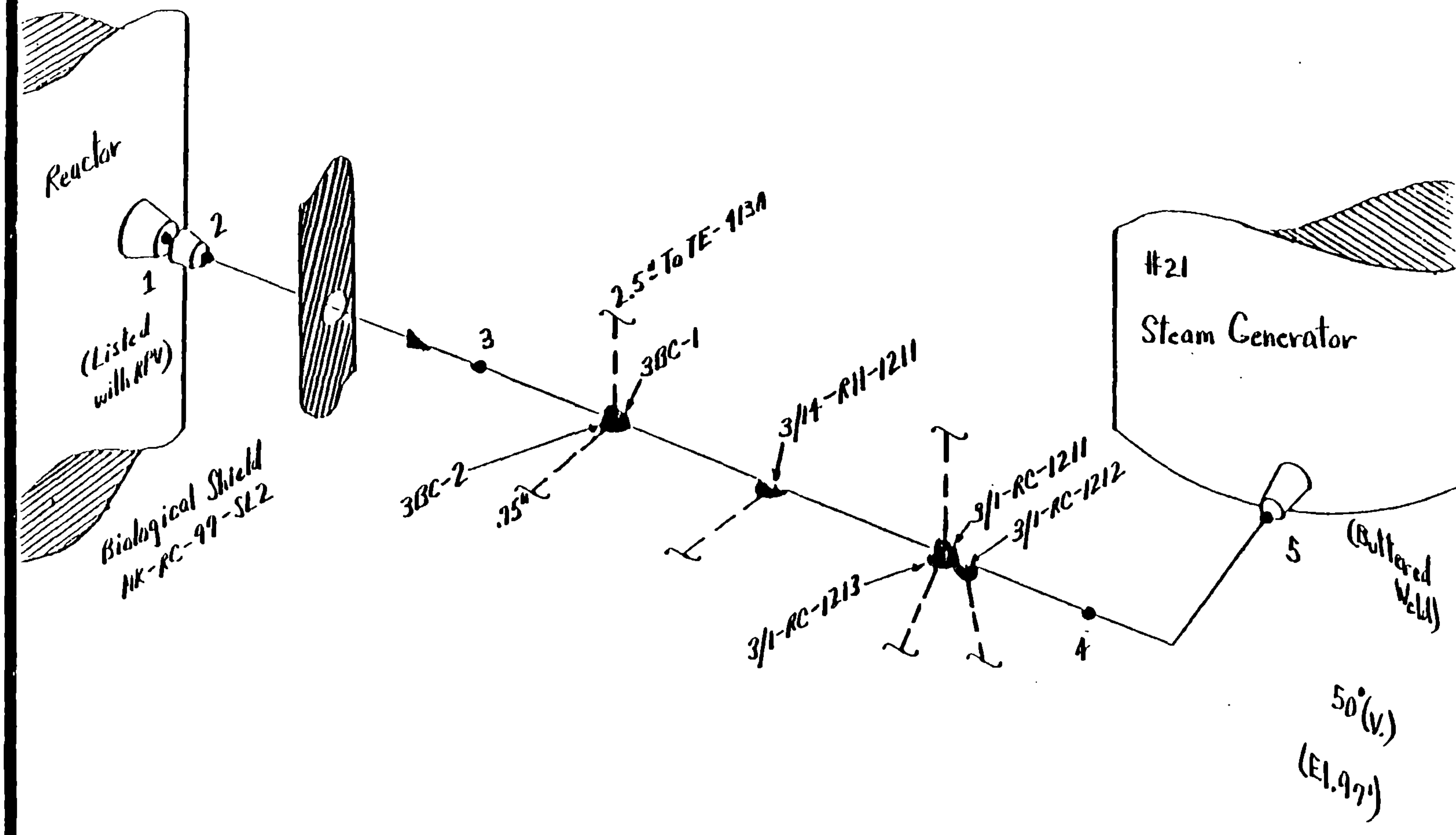
29-RC-1230
LOOP #23 HOT LEG
FIG. A-34A



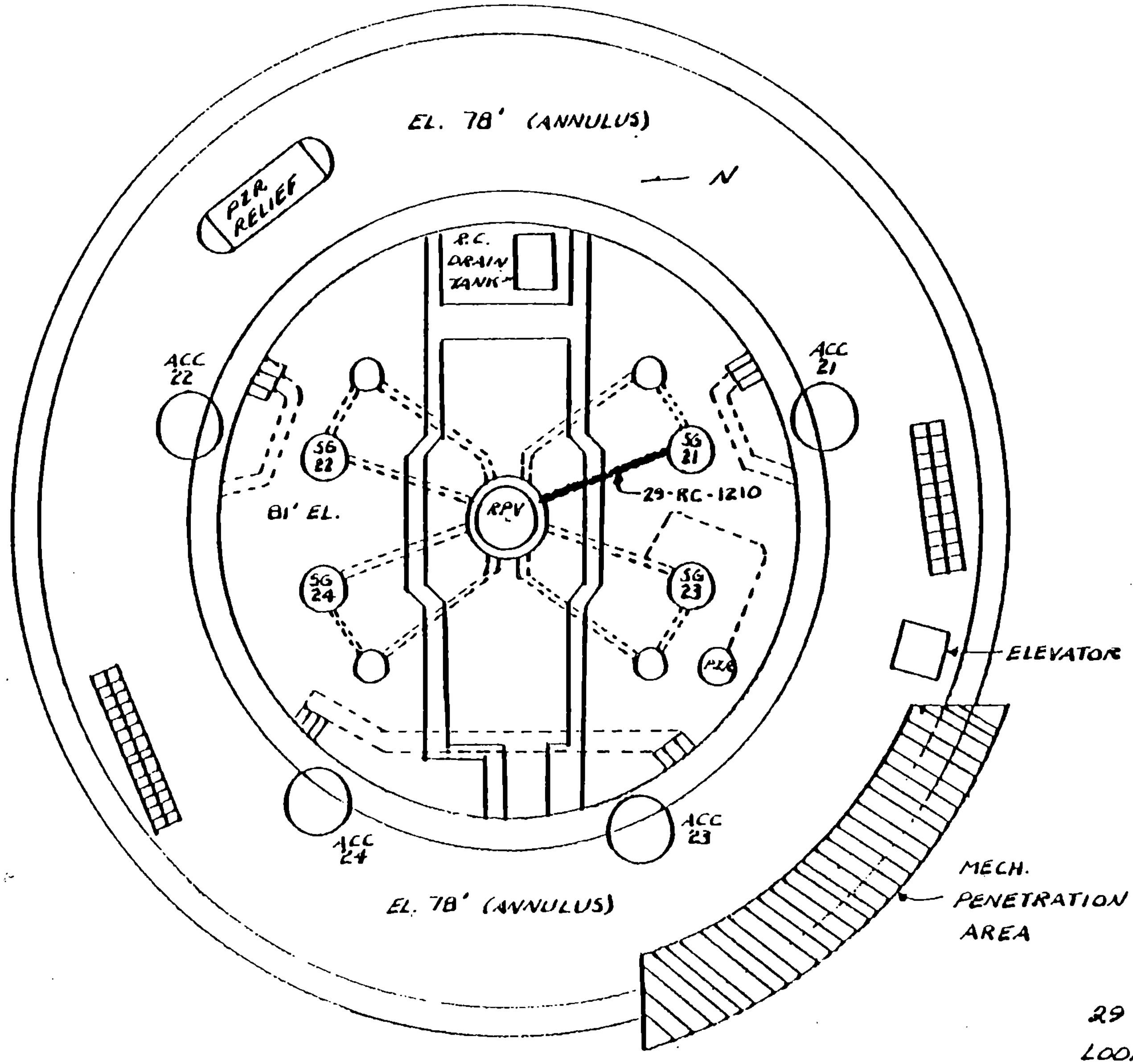
PSE&G No: 29"-2RC1003	PSE&G Dwg: RC-2-3 Sht. 1	Thickness: 2.335" Min. Wall
SwRI No: 29-RC-1220	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-35



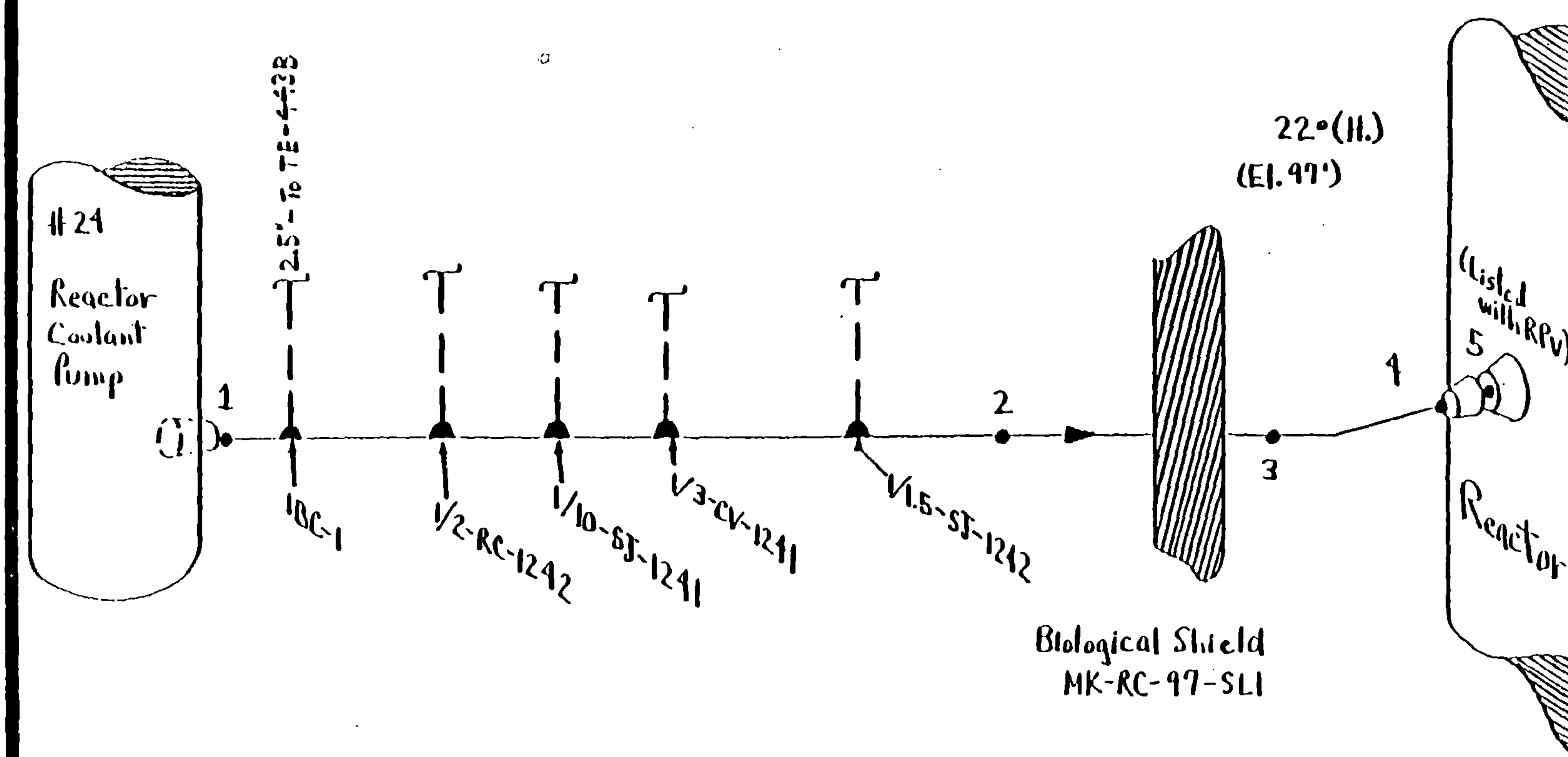
29-RC-1220
LOOP #22 HOT LEG
FIG. A-35A



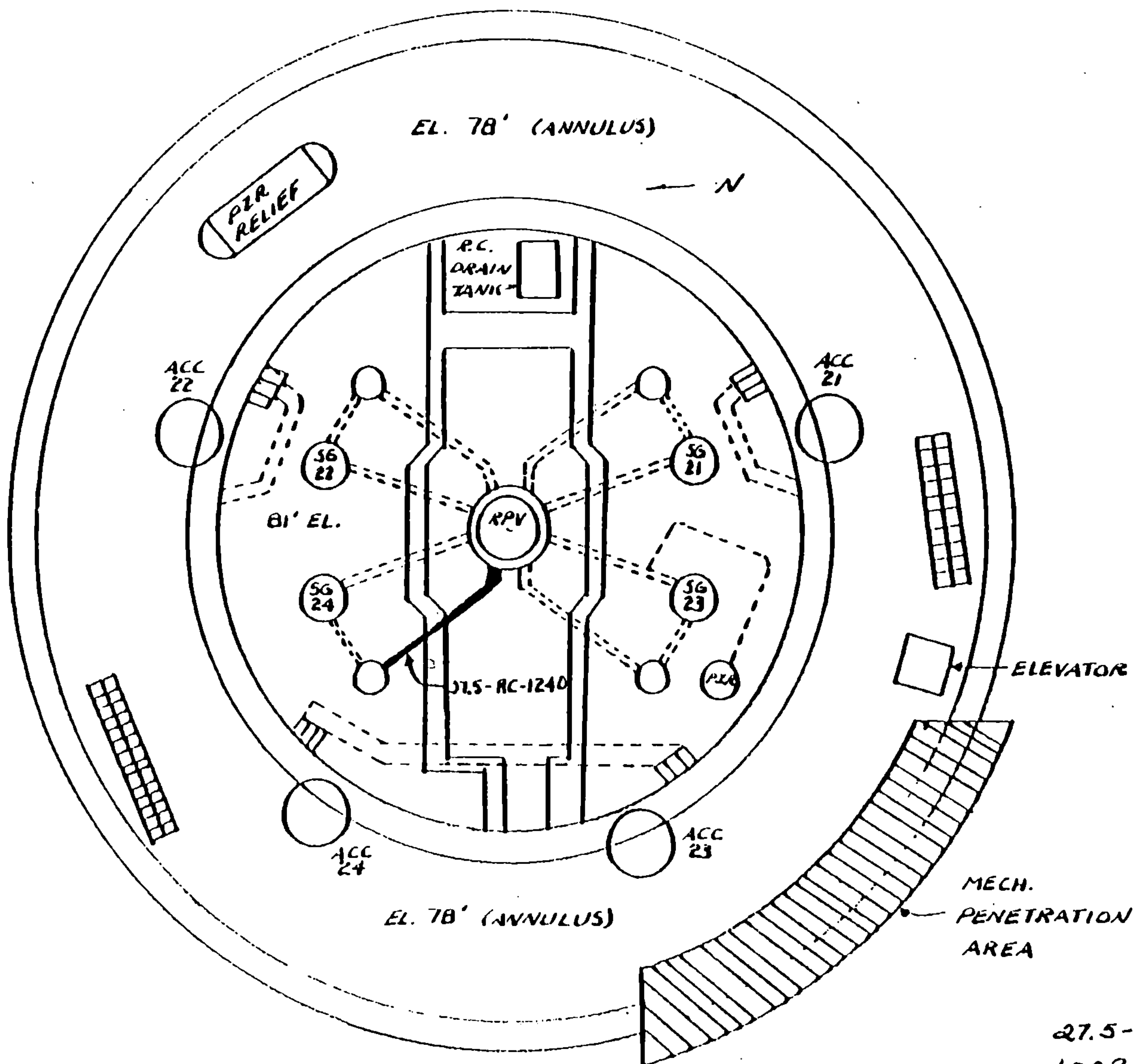
PSE&G No: 29"-2RC1000	PSE&G Dwg: RC-2-3 Sht. 1	Thickness: 2.335" Min. Wall
SwRI No: 29-RC-1210	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-36



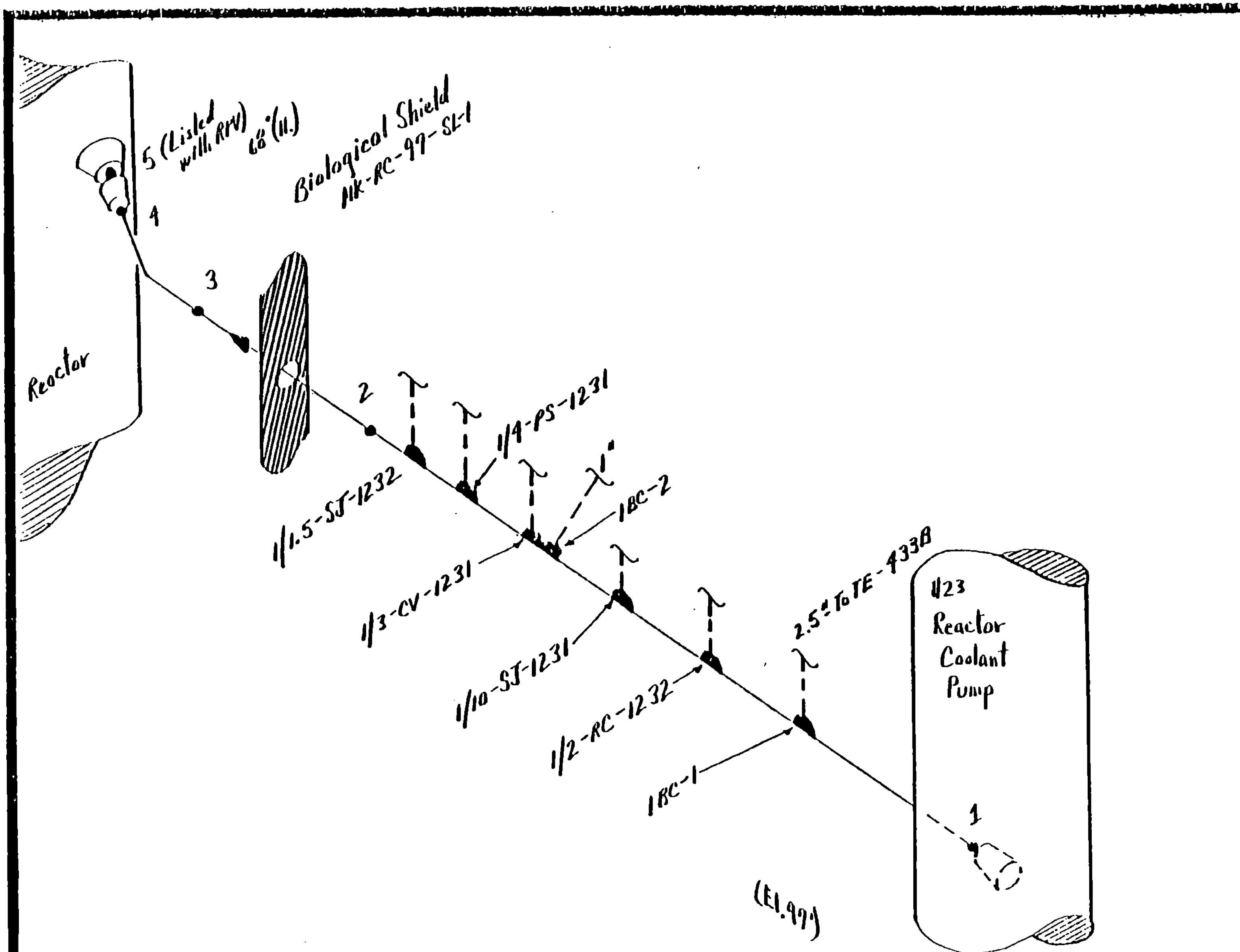
29-RC-1210
LOOP #21 HOT LEG
FIG. A-36A



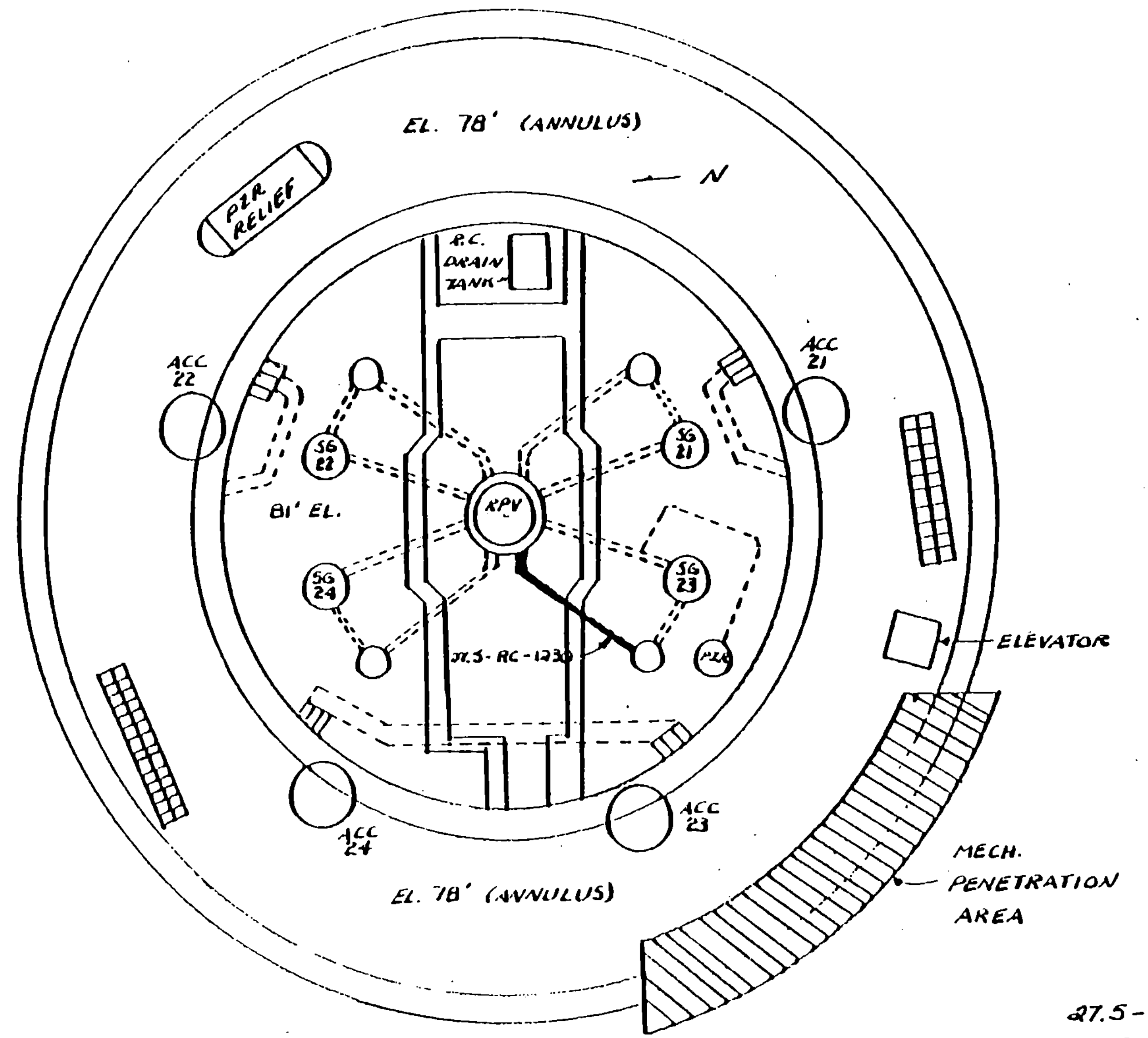
PSBAG No: 27.5"-2RC-1011	PSBAG Dwg: RC-2-3 Sht. 2	Thickness: 2.215" Min. Wall
SwRI No: 27.5-RC-1240	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-37



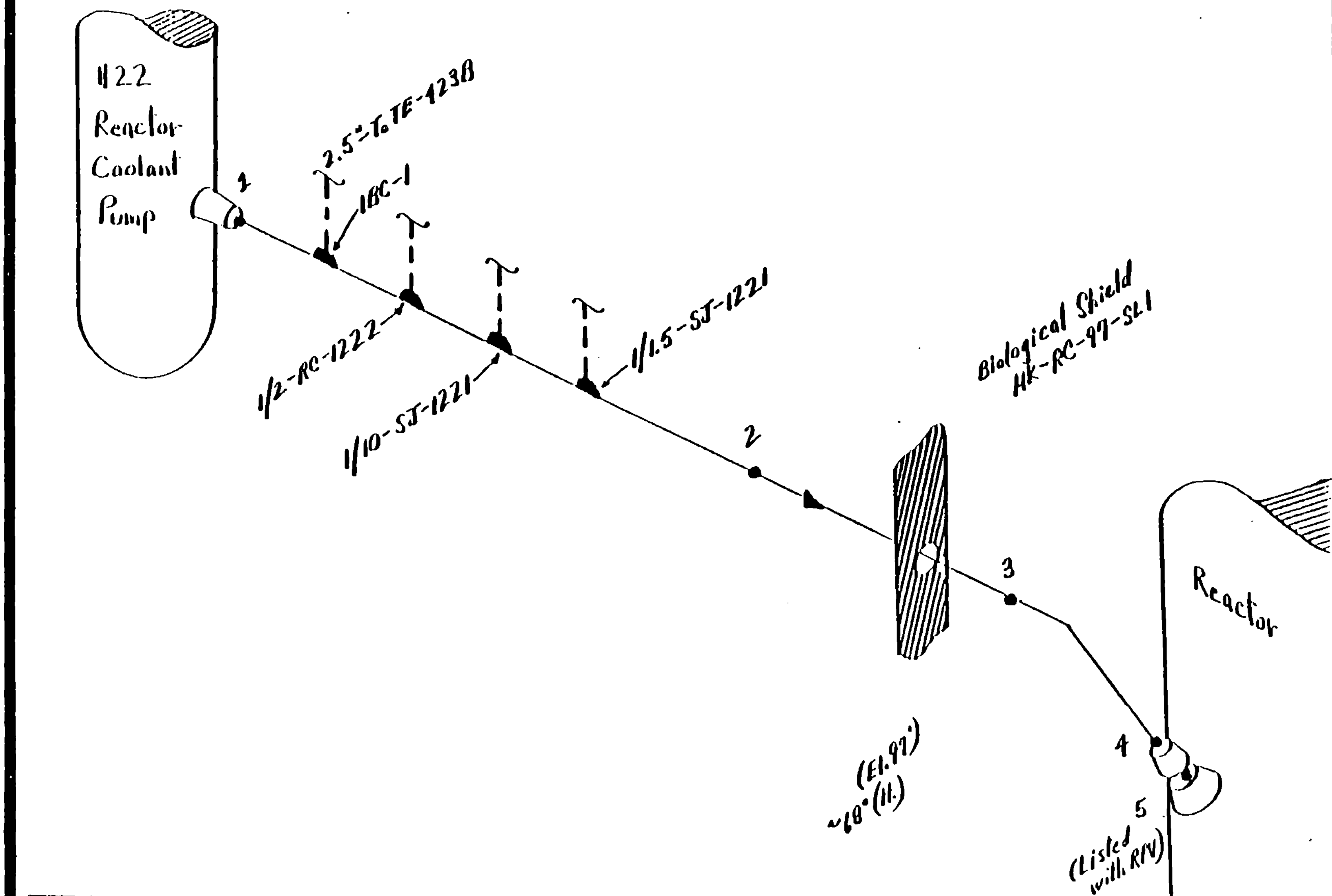
27.5-RC-1240
LOOP #24 COLD LEG
FIG. A-37A



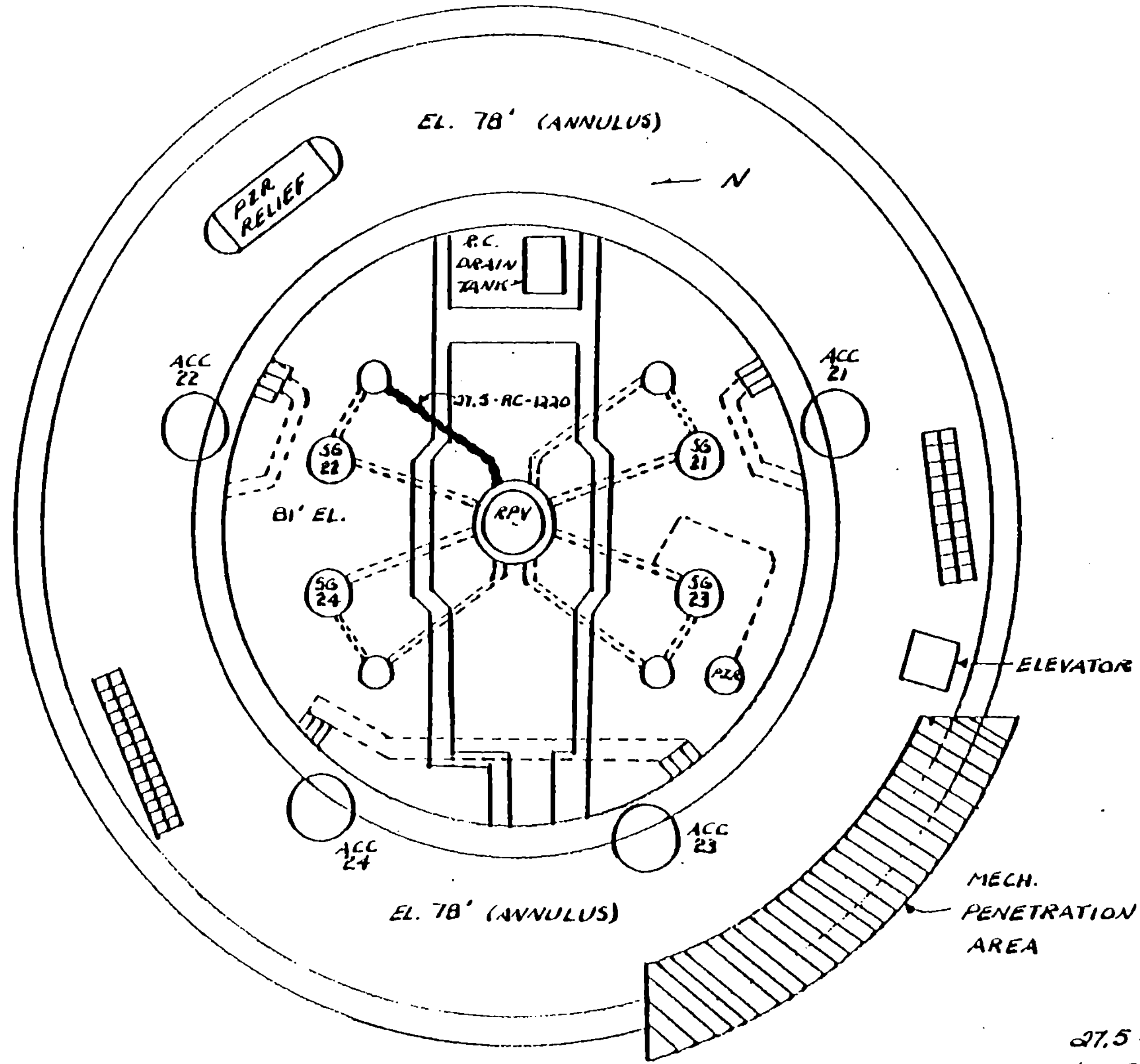
PSB&G No: 27.5"-2RC-1008	PSB&G Dwg: RC-2-3 Sht. 2	Thickness: 2.215" Min. Wall
SwRI No: 27.5-RC-1230	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-38



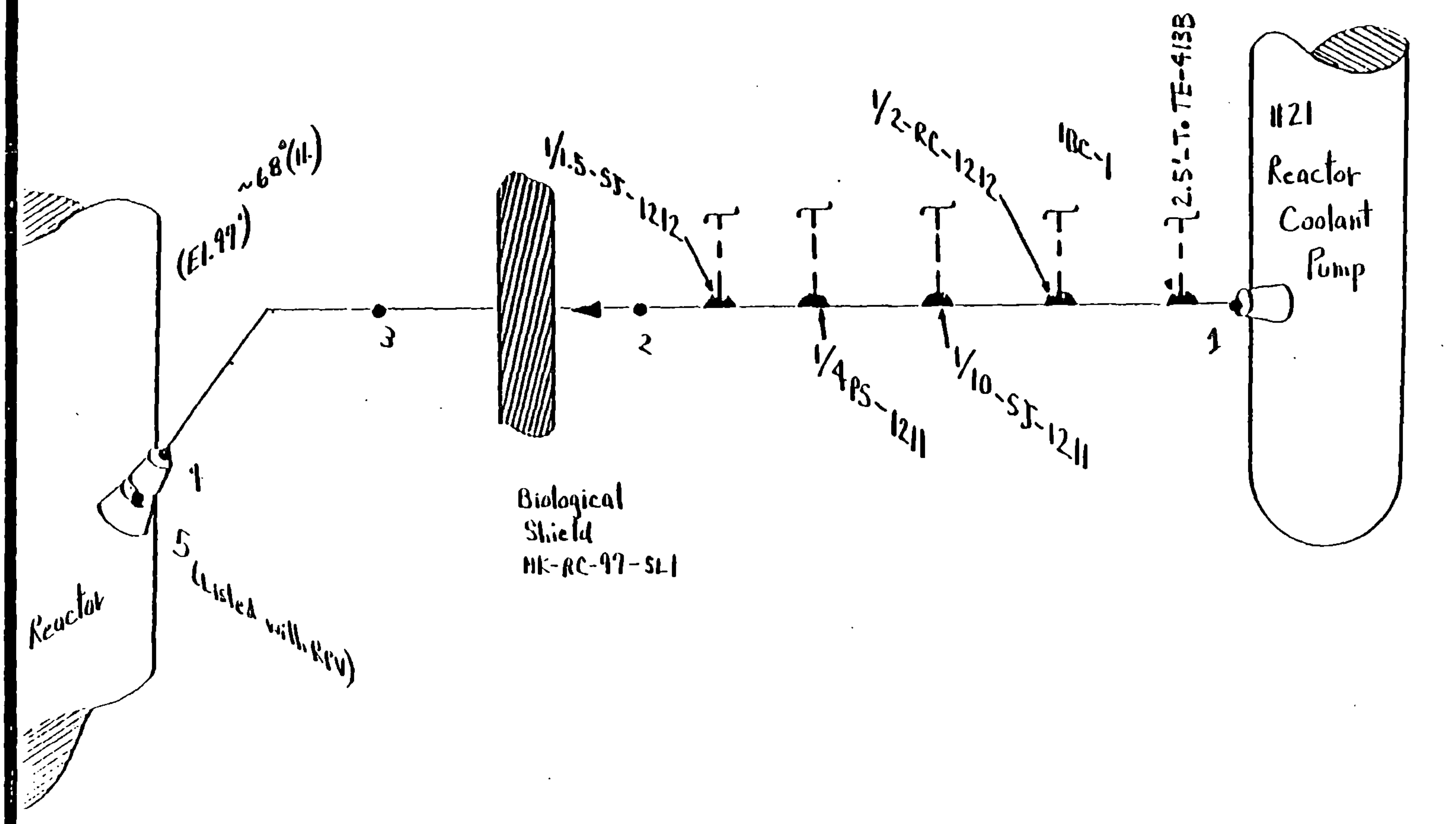
27.5 - RC - 1230
LOOP #23 COLD LEG
FIG. A-38A



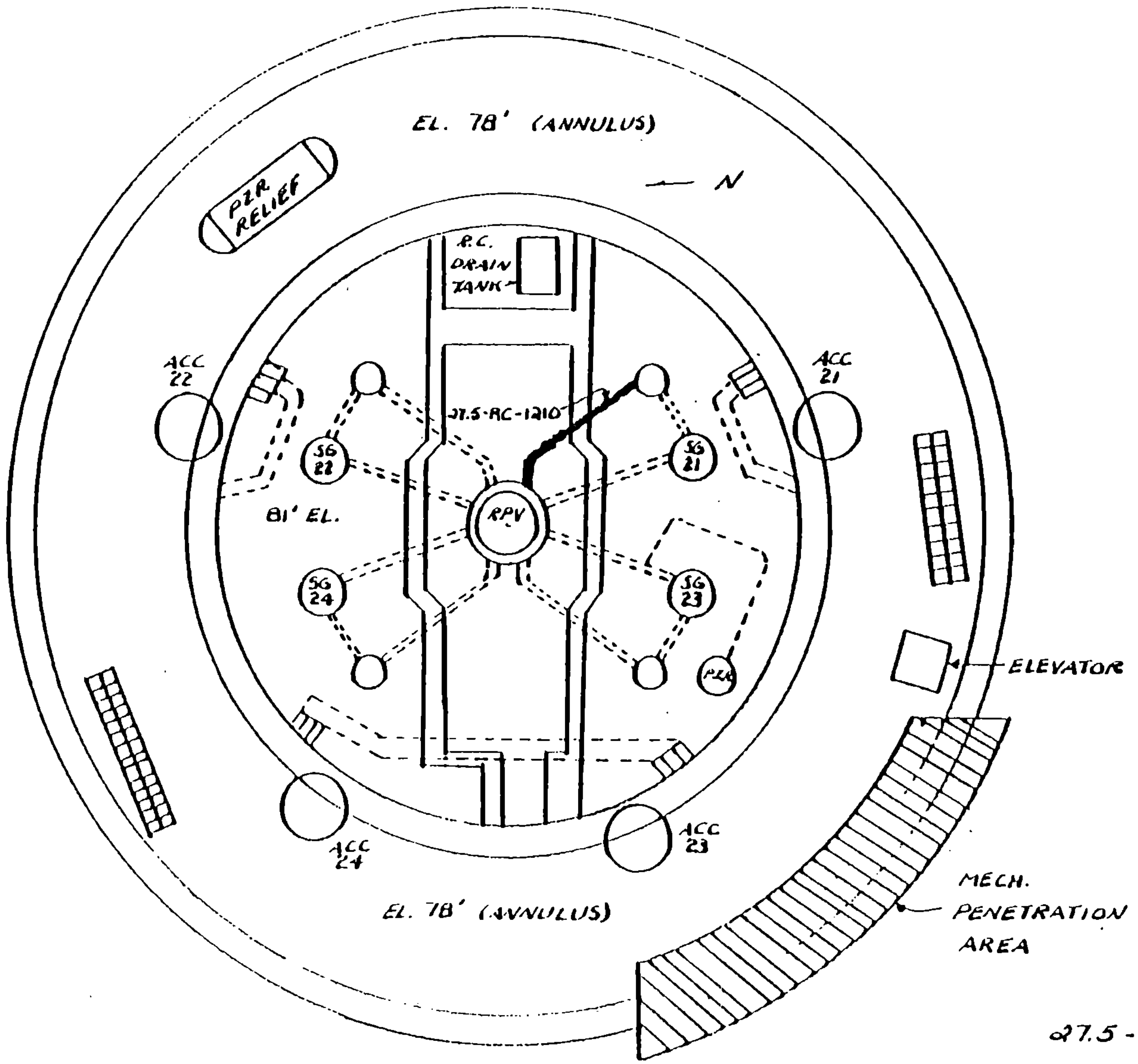
PSE&G No: 27.5"-2RC-1005	PSE&G Dwg: RC-2-3 Sht. 1	Thickness: 2.215" Min. Wall
SwRI No: 27.5-RC-1220	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-39



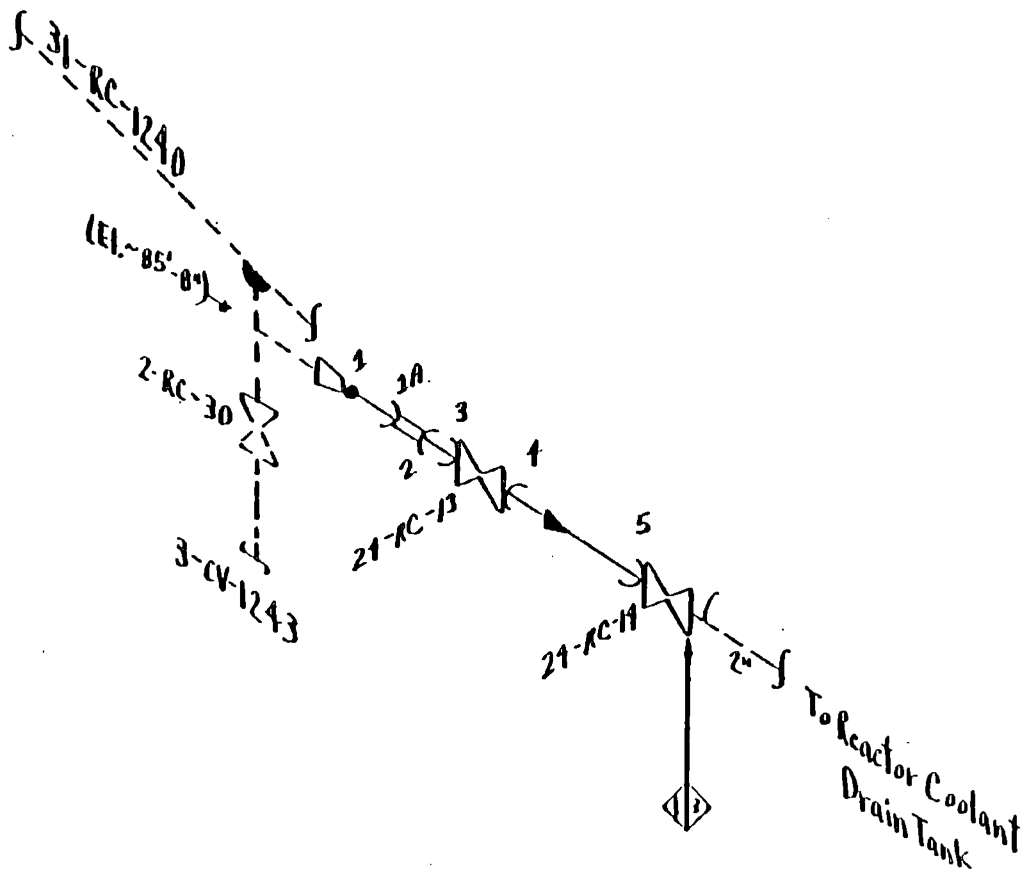
27.5 - RC - 1220
LOOP #22 COLD LEG
FIG. A-39A



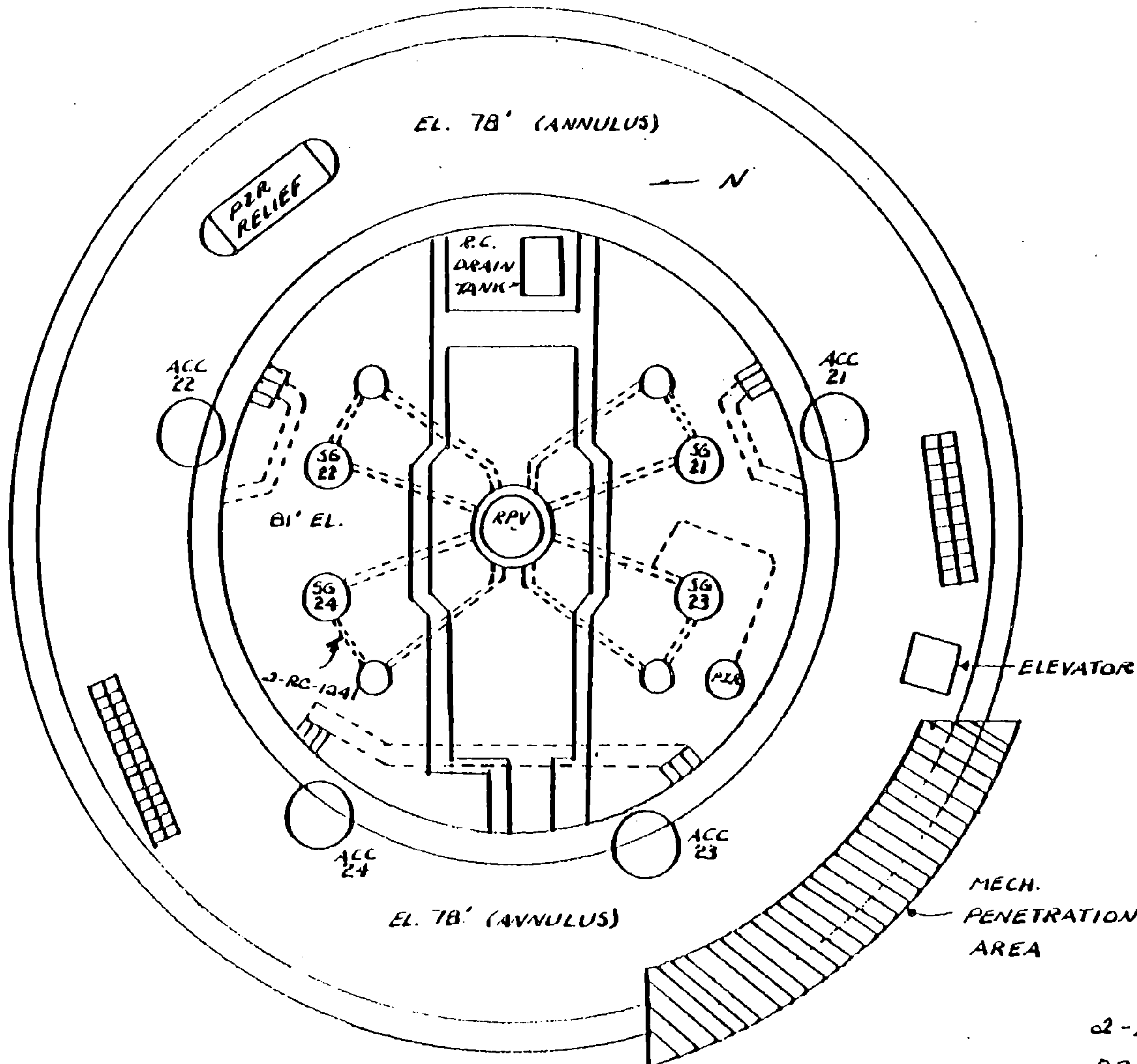
PSHAG No: 27.5"-2RC1002	PSHAG Dwg: RC-2-3 Sht. 1	Thickness: 2.215" Min. Wall
SwRI No: 27.5-RC-1210	Basic Cal. Blk.: 2.312-SS-37-SAM (plate)	Figure: A-40



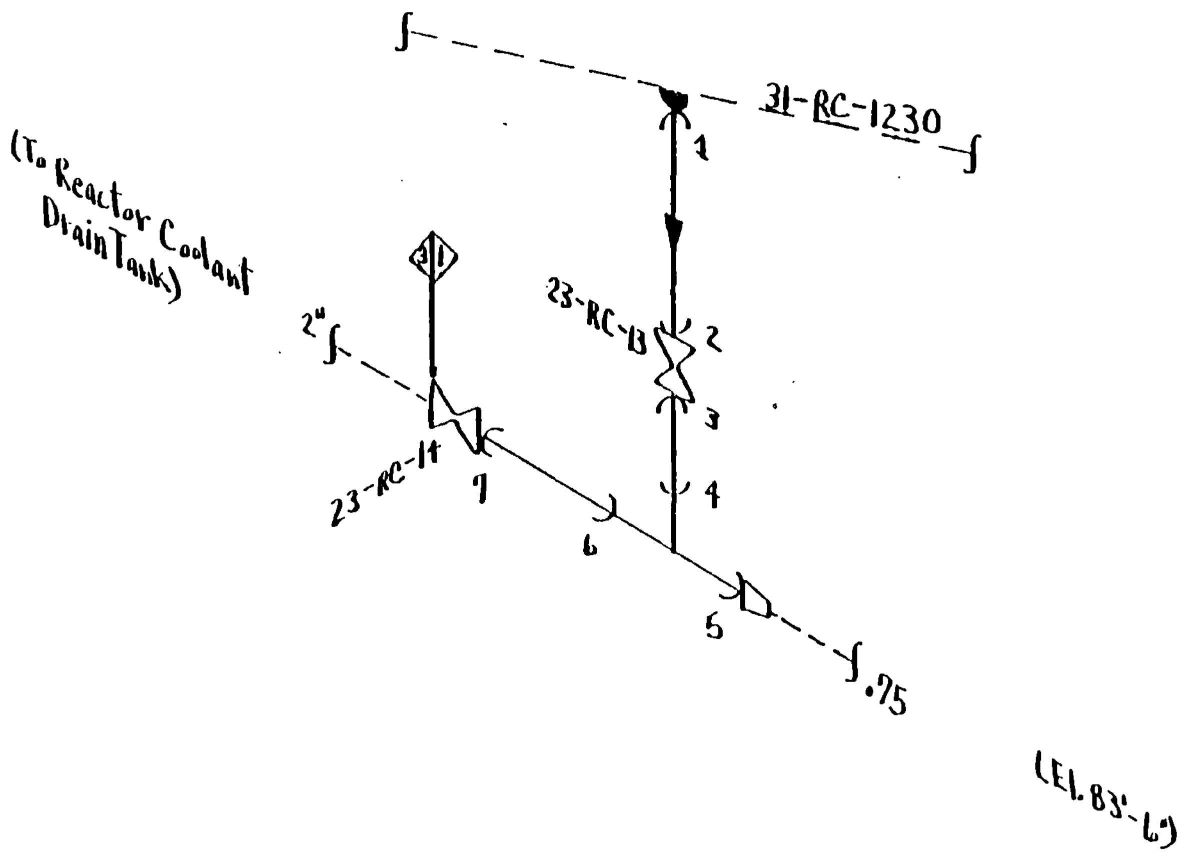
27.5 - RC - 1210
LOOP #21 COLD LEG
FIG. A-40A



PSB&G No: 2"-RC1110	PSB&G Dwg: RC-2-3 Sht. 19	Thickness: 0.344"
SwRI No: 2-RC-1241	Basic Cal. Blk.: 2-SS-160-.330-39-SAM	Figure: A-47

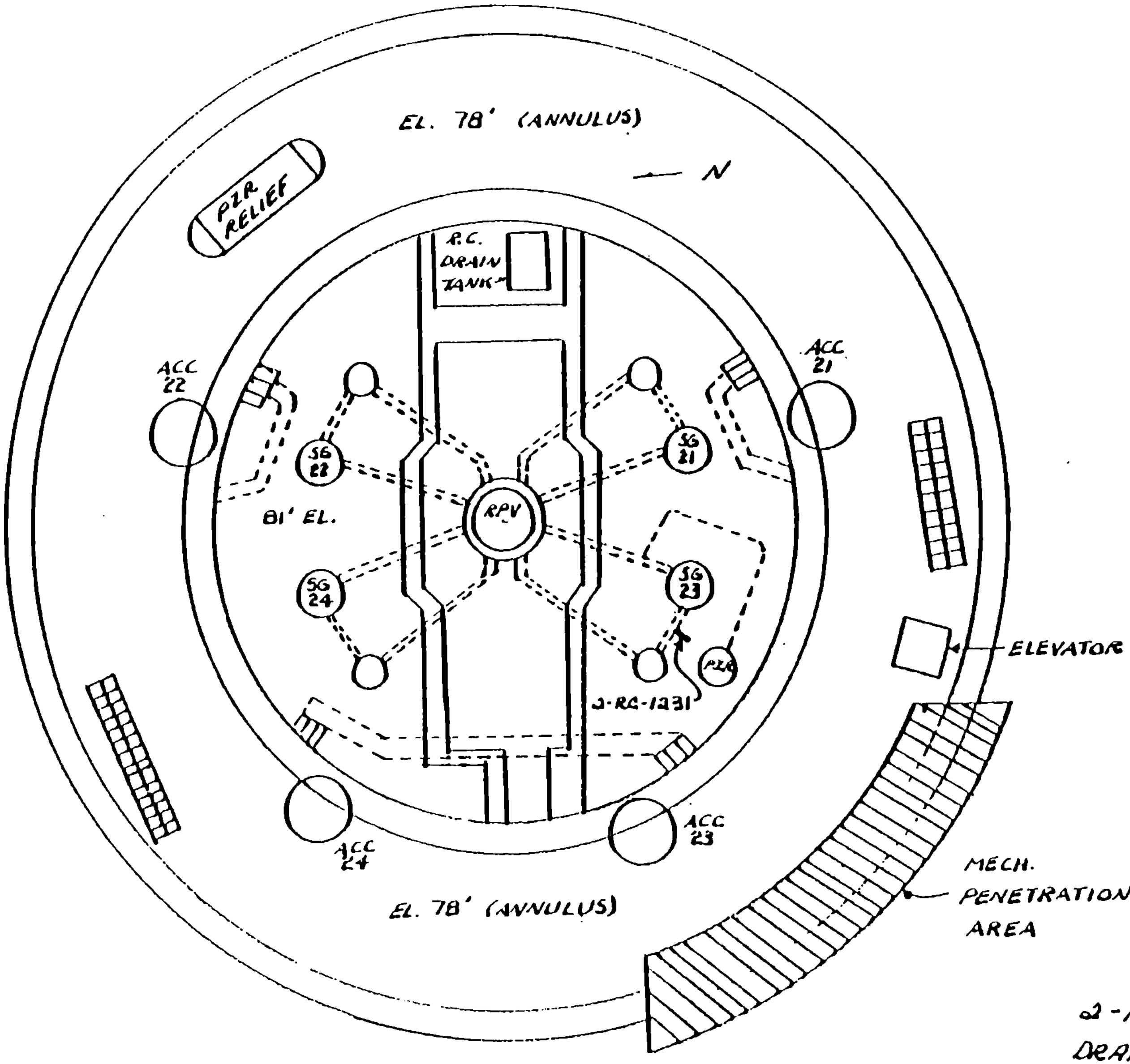


2-RC-1241
DRAIN LINE
FIG. A-47A

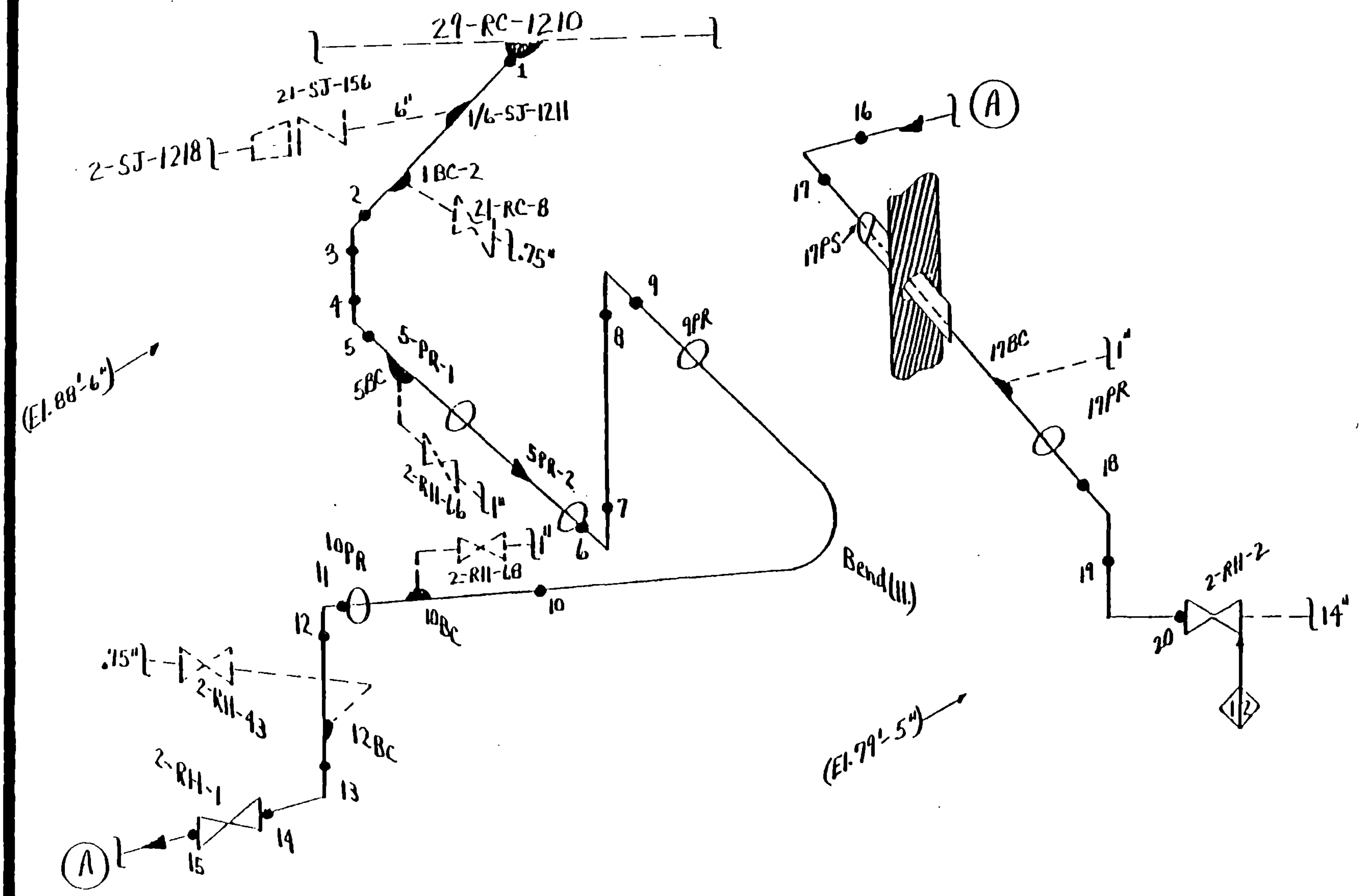


PSE&G No: 2"-RC1087	PSE&G Dwg: RC-2-3 Sht. 17	Thickness:0.344"
SwRI No: 2-RC-1231	Basic Cal. Blk.: N/A	Figure: A-50

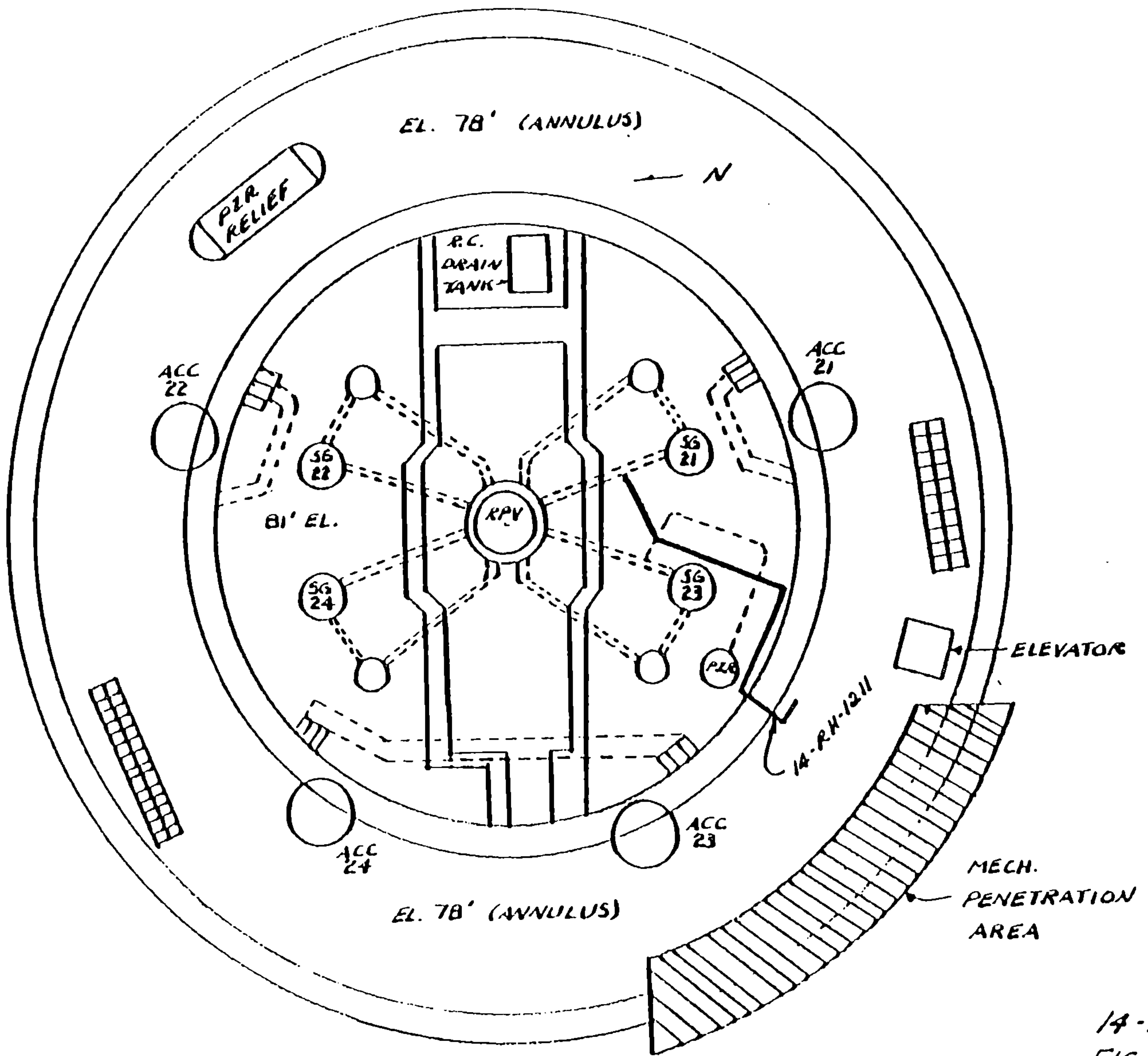
A-45



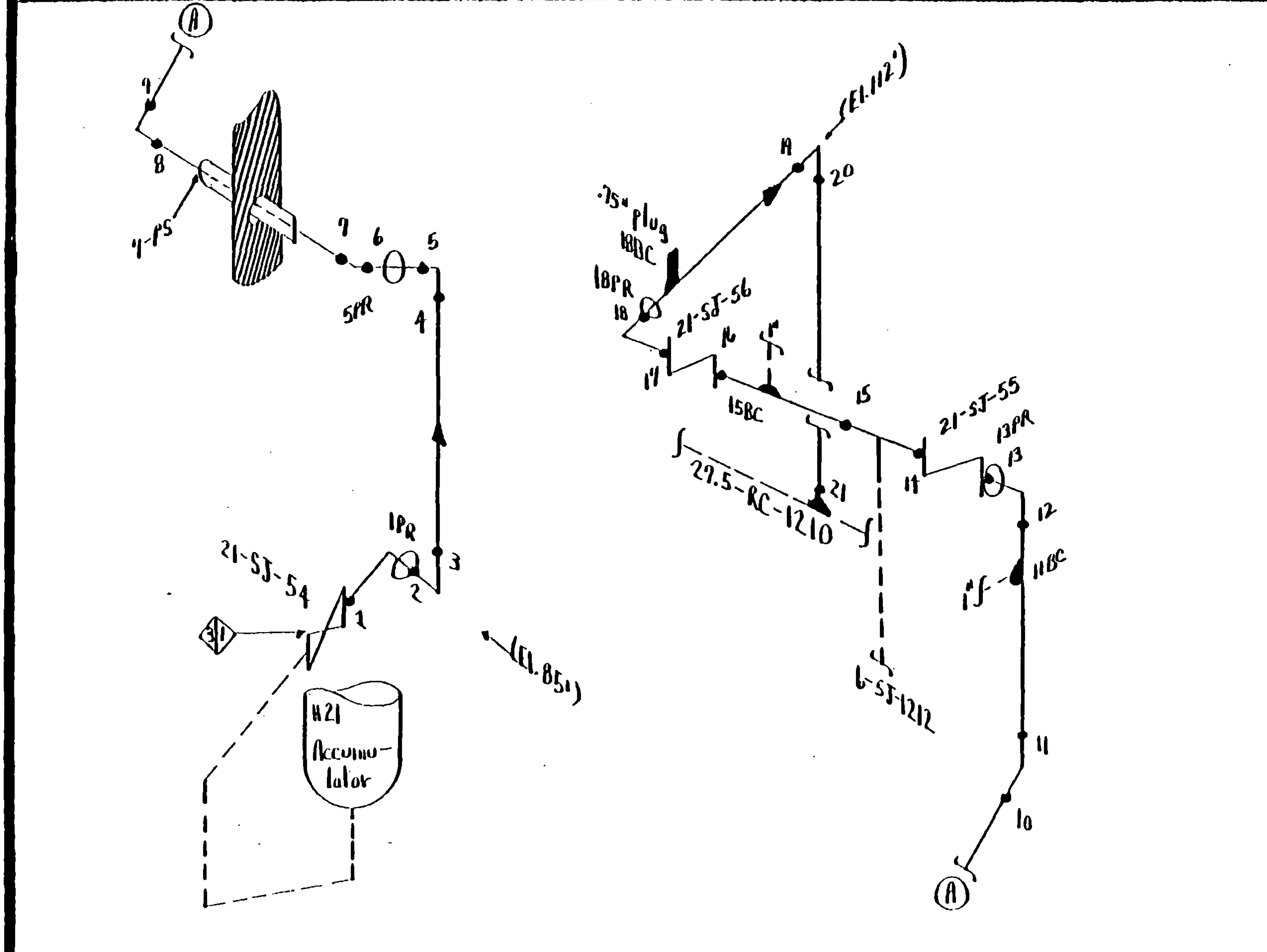
2-RC-1231
DRAIN LINE
FIG. A-50A



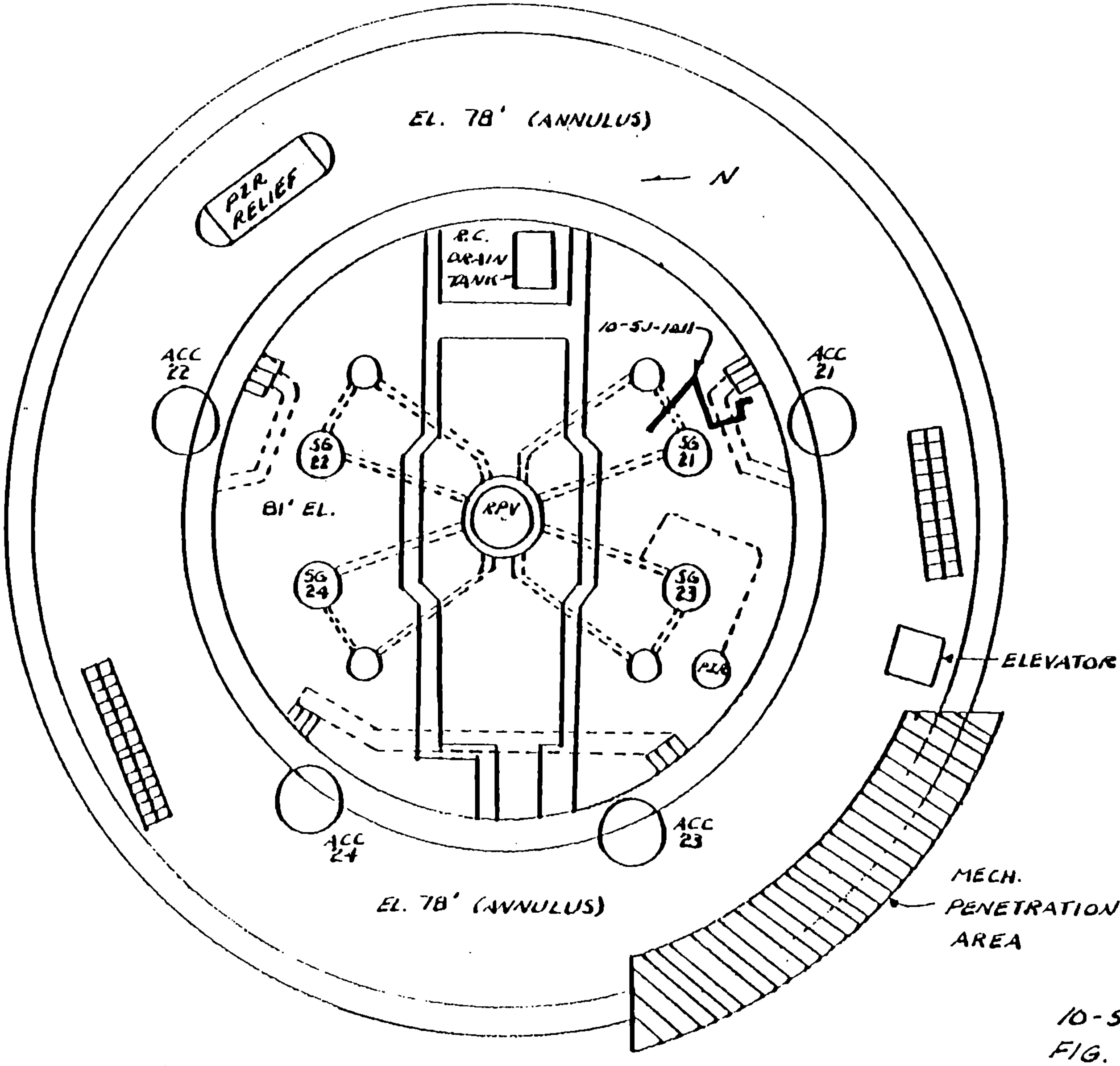
PSBRG No: 14"-2RH1000	PSBRG Dwg: RH-2-3 Sht. 4	Thickness: 1.406"
SwRI No: 14-RH-1211	Basic Cal. Blk.: 14-SS-160-1.40-78-SAM	Figure: A-61



14-RH-1211
FIG. A-61A

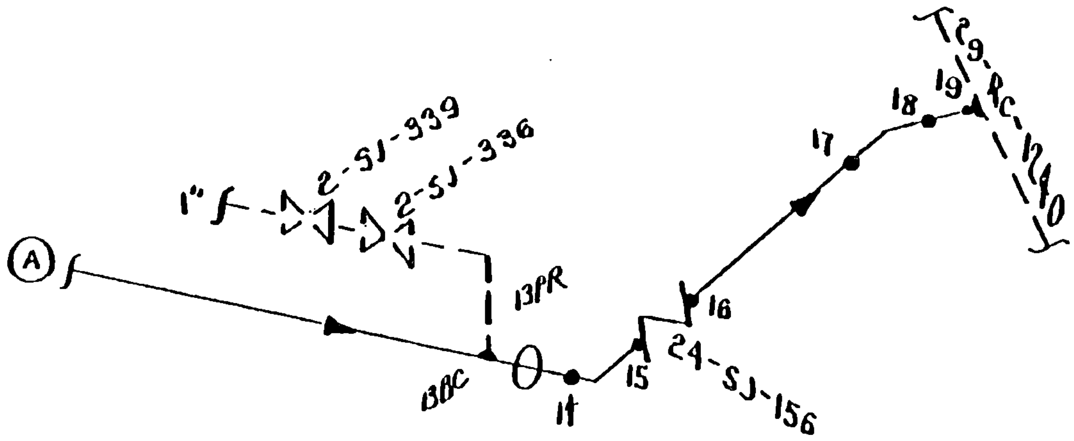


PSR&G No: 10"-2SJ1036	PSR&G Dwg: RH 2-3- Sht. 1	Thickness: 1.125"
SwRI No: 10-SJ-1211	Basic Cal. Blk.: 10-SS-160-1.119-22-SAM	Figure: A-66



10-SJ-1211
FIG. A-66A

A-51



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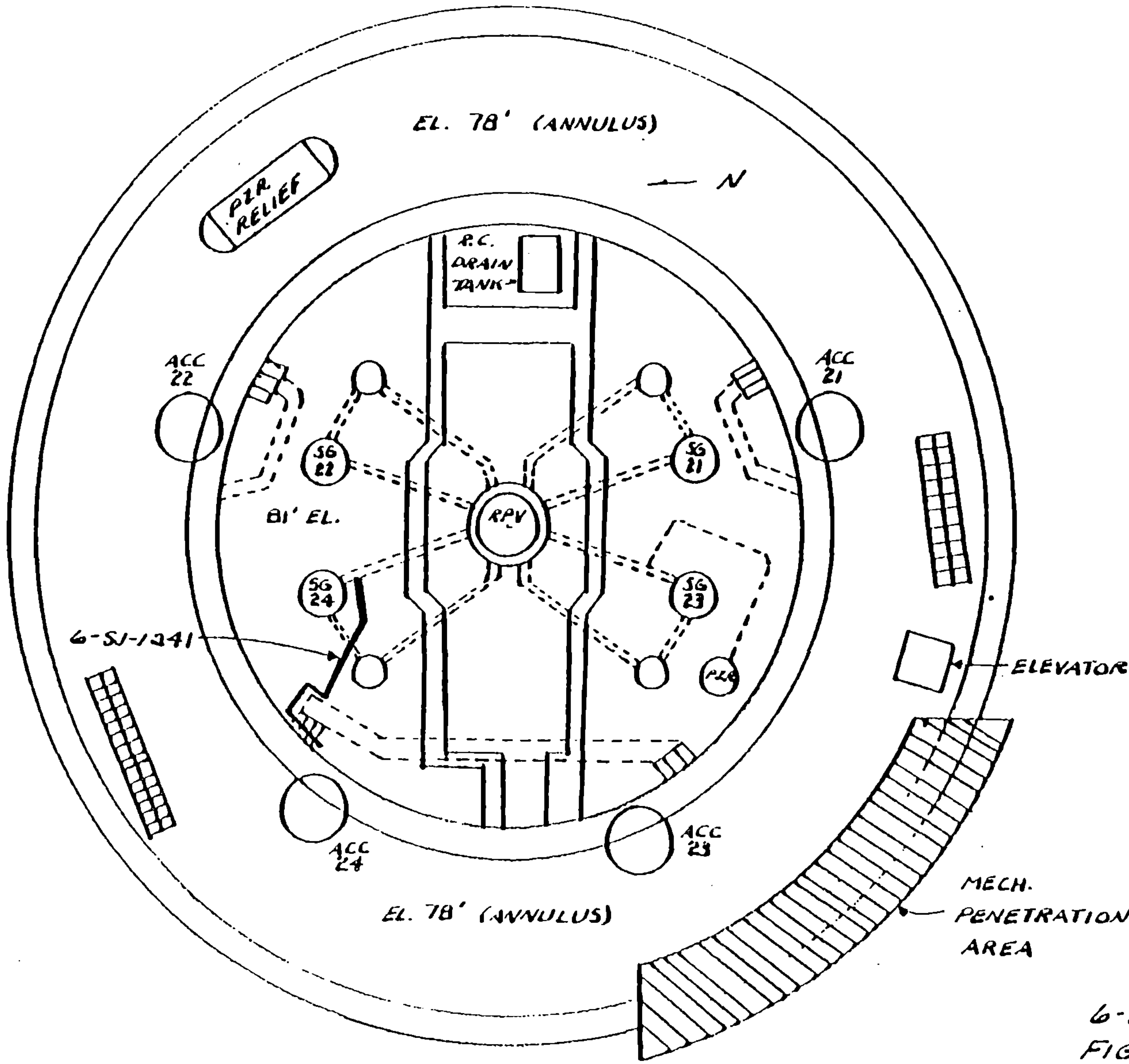
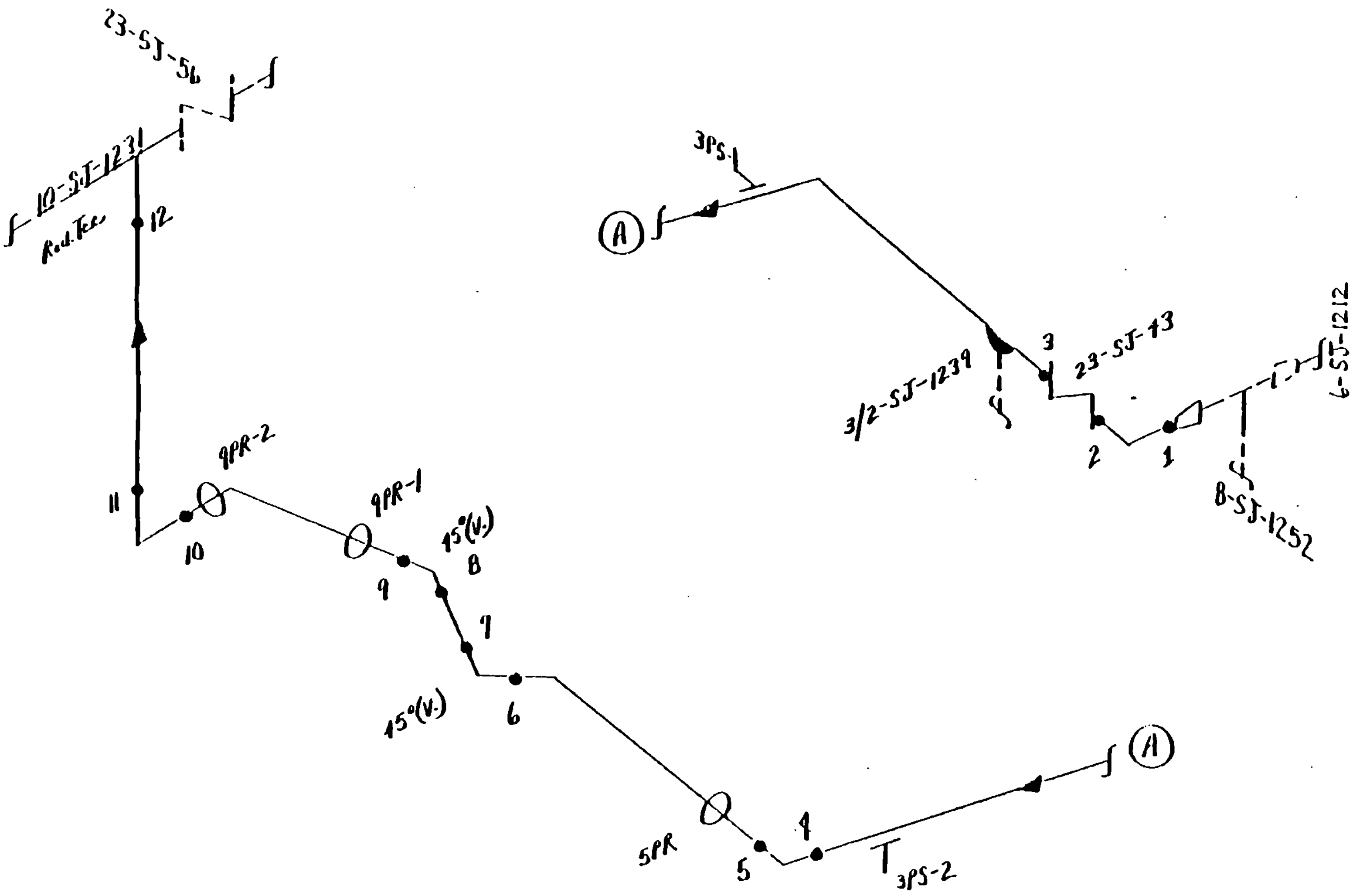
PSR&G No: 6"-2SJ1170	PSR&G Dwg: RH-2-3 Sht. 2	Thickness: 0.719"
SwRI No: 6-SJ-1241	Basic Cal. Blk.: 6-SS-160-.764-25-SAM	Figure: A-75

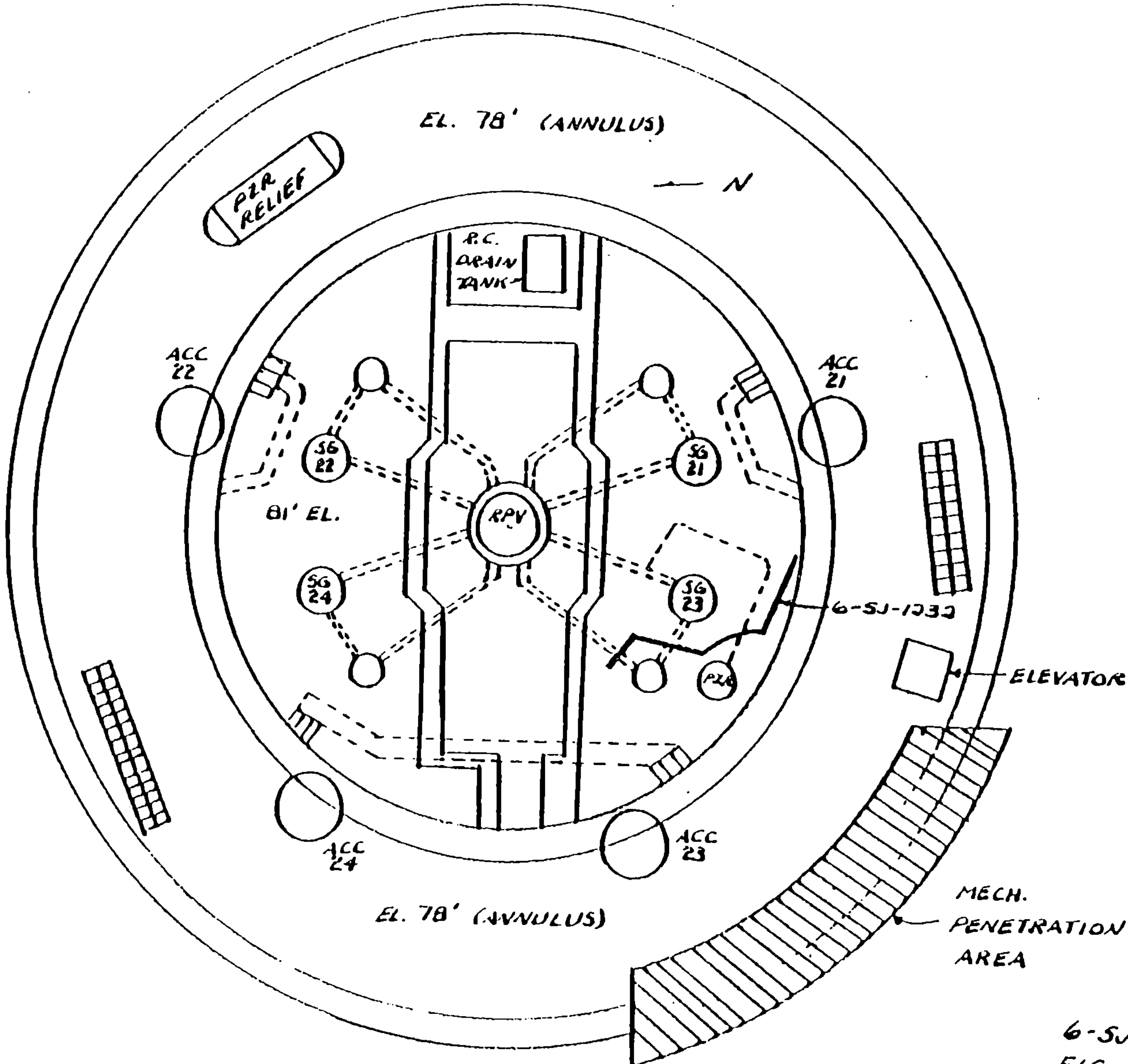


6-SJ-1241
FIG. A-75A

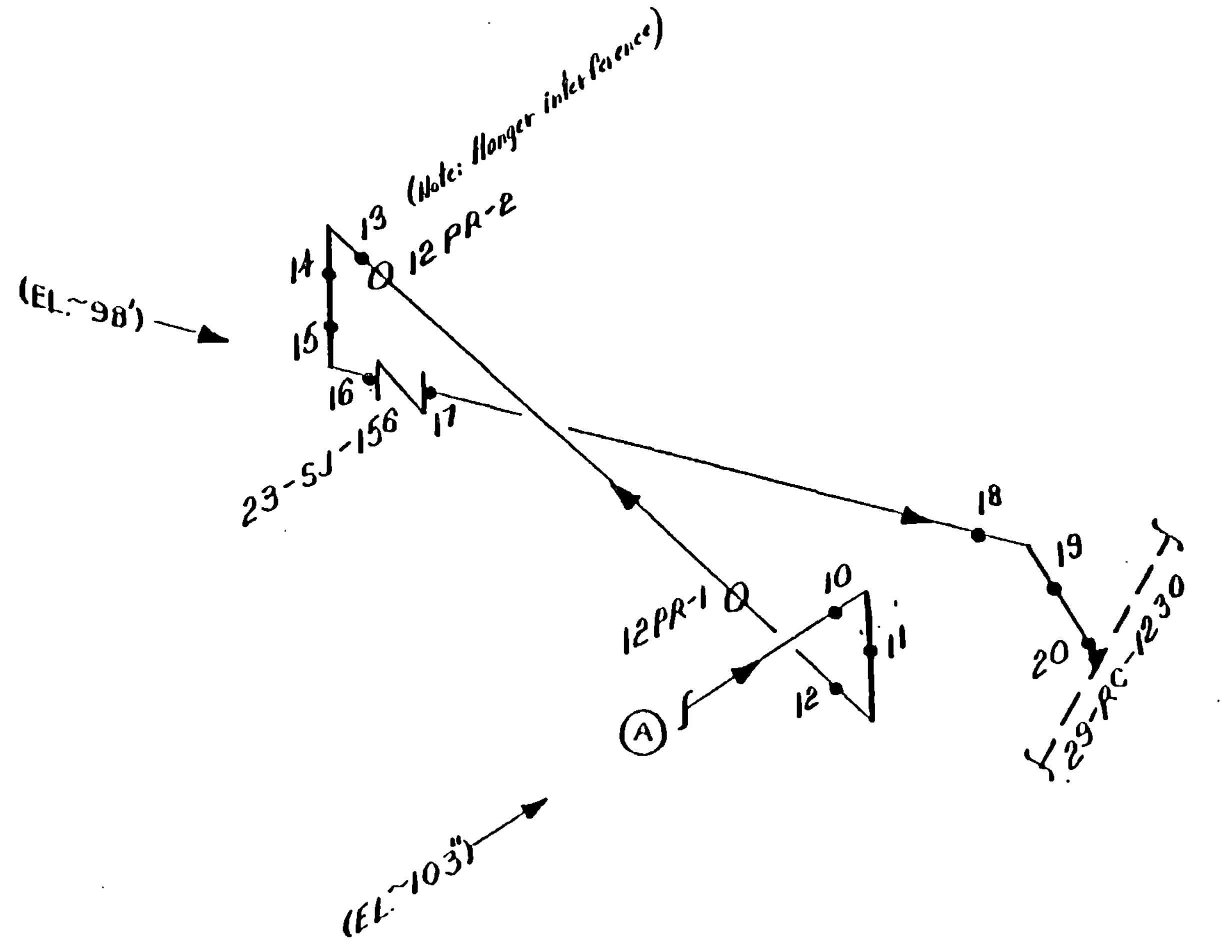


PSE&G No: 6"-2SJ1050	PSE&G Dwg: RH-2-3 Sht. 1	Thickness: 0.719"
SwRI No: 6-SJ-1232	Basic Cal. Blk.: 6-SS-160-.764-25-SAM	Figure: A-76

A-53



6-SJ-1232
FIG. A-76A



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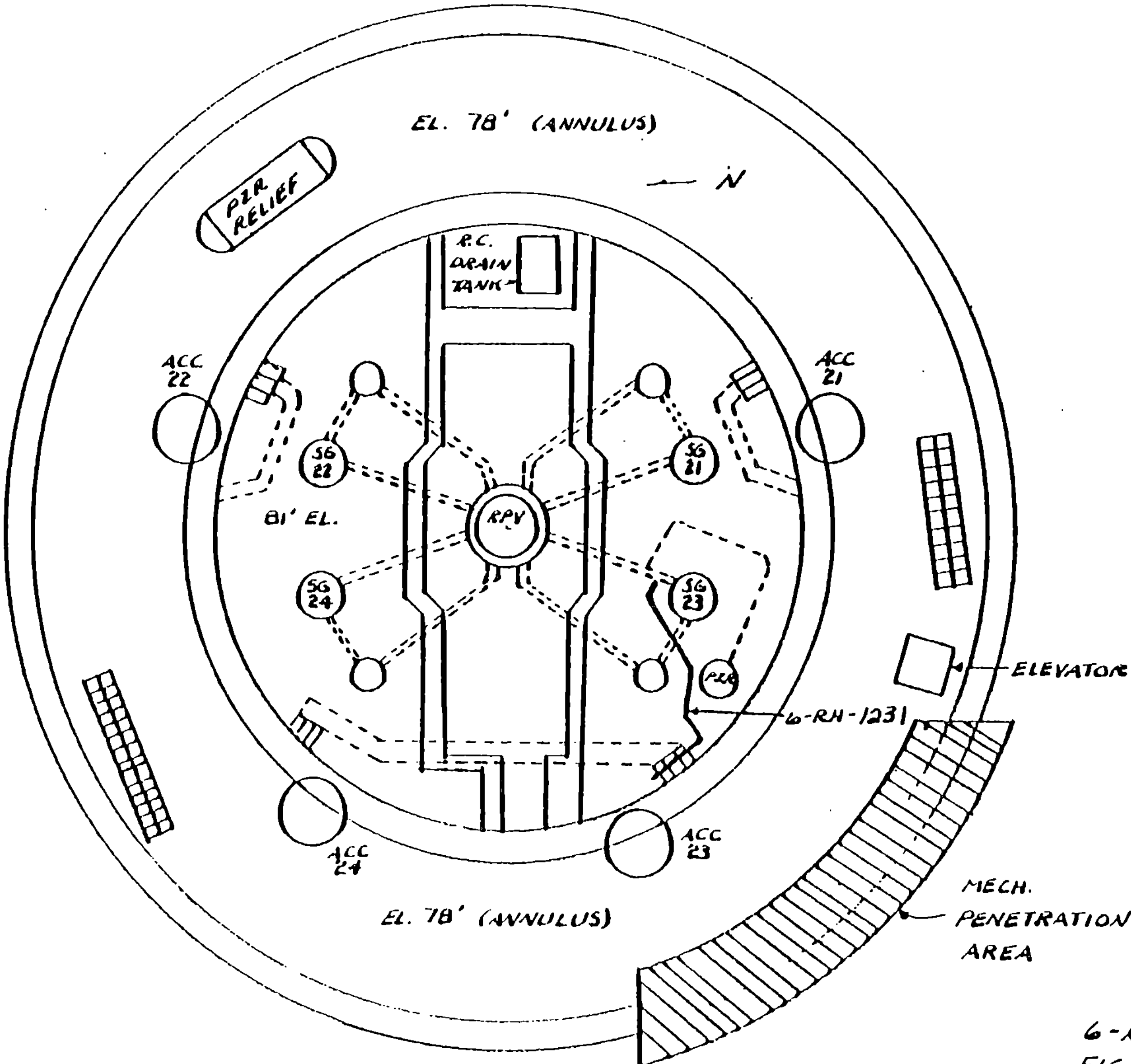
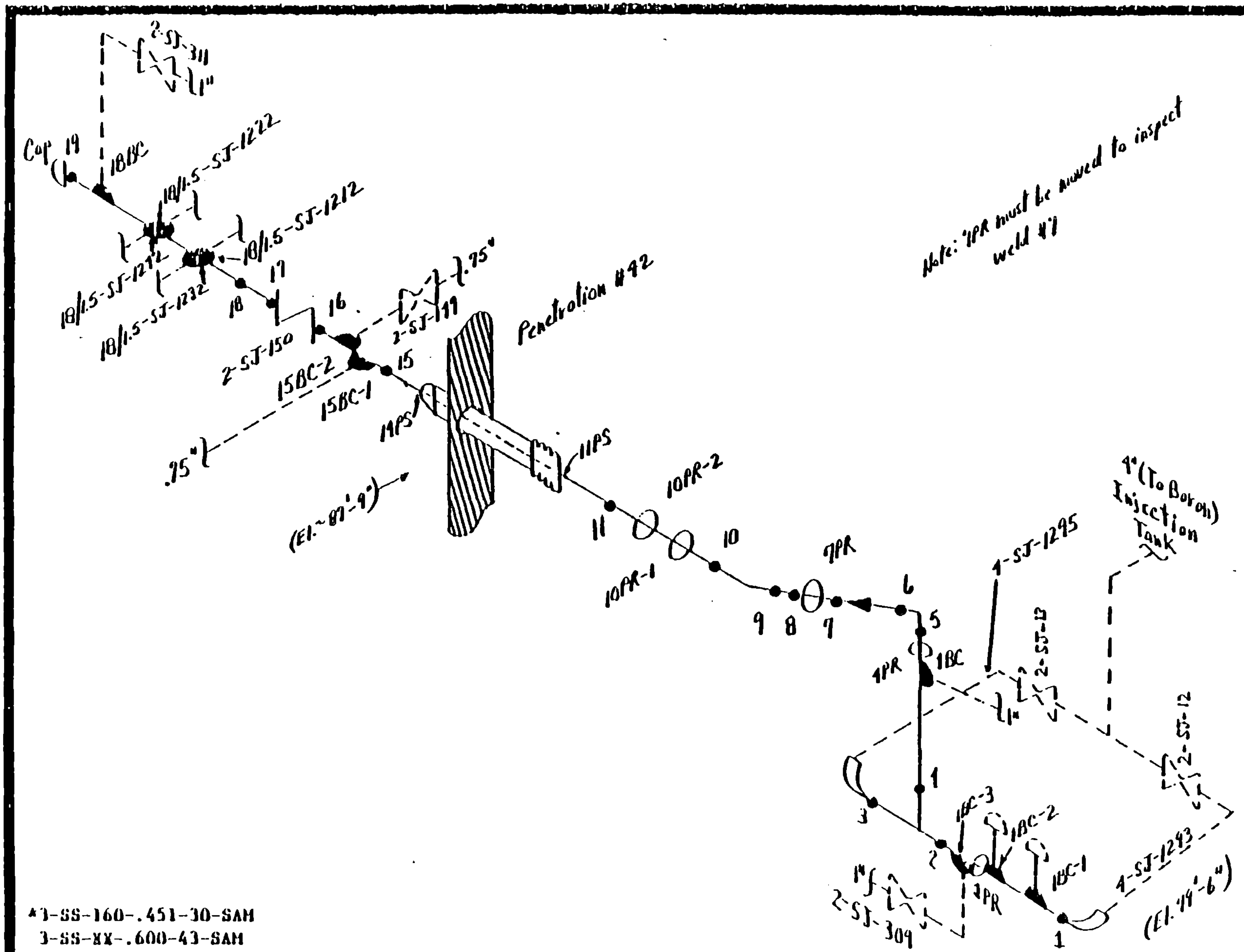
PSR&G No: 6"-2SJ1171	PSR&G Dwg: RH-2-3 Sht. 2	Thickness: 0.719"
SwRI No: 6-SJ-1231	Basic Cal. Blk.: 6-SS-160-.764-25-SAM	Figure: A-78

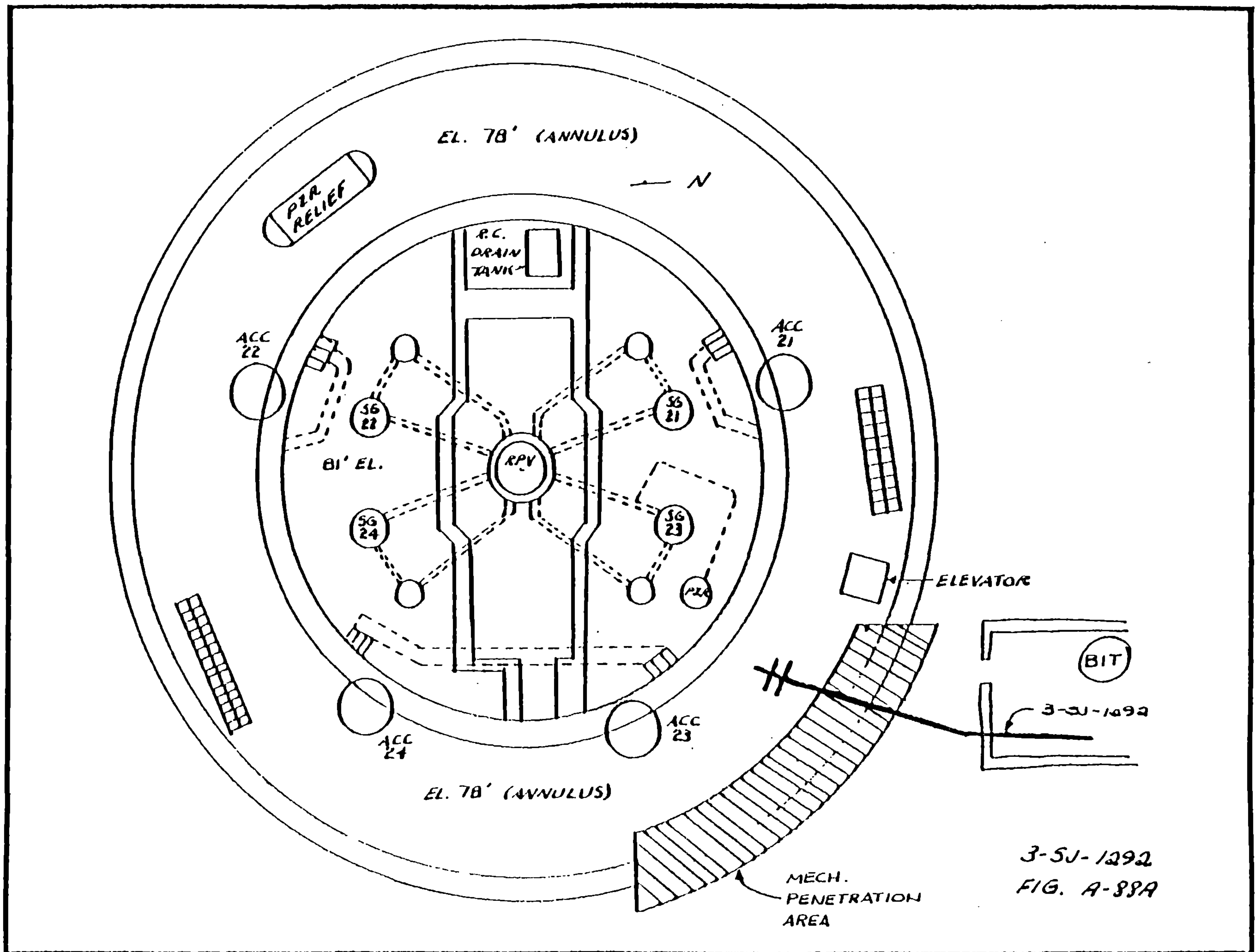


6-RH-1231
FIG. A-78A

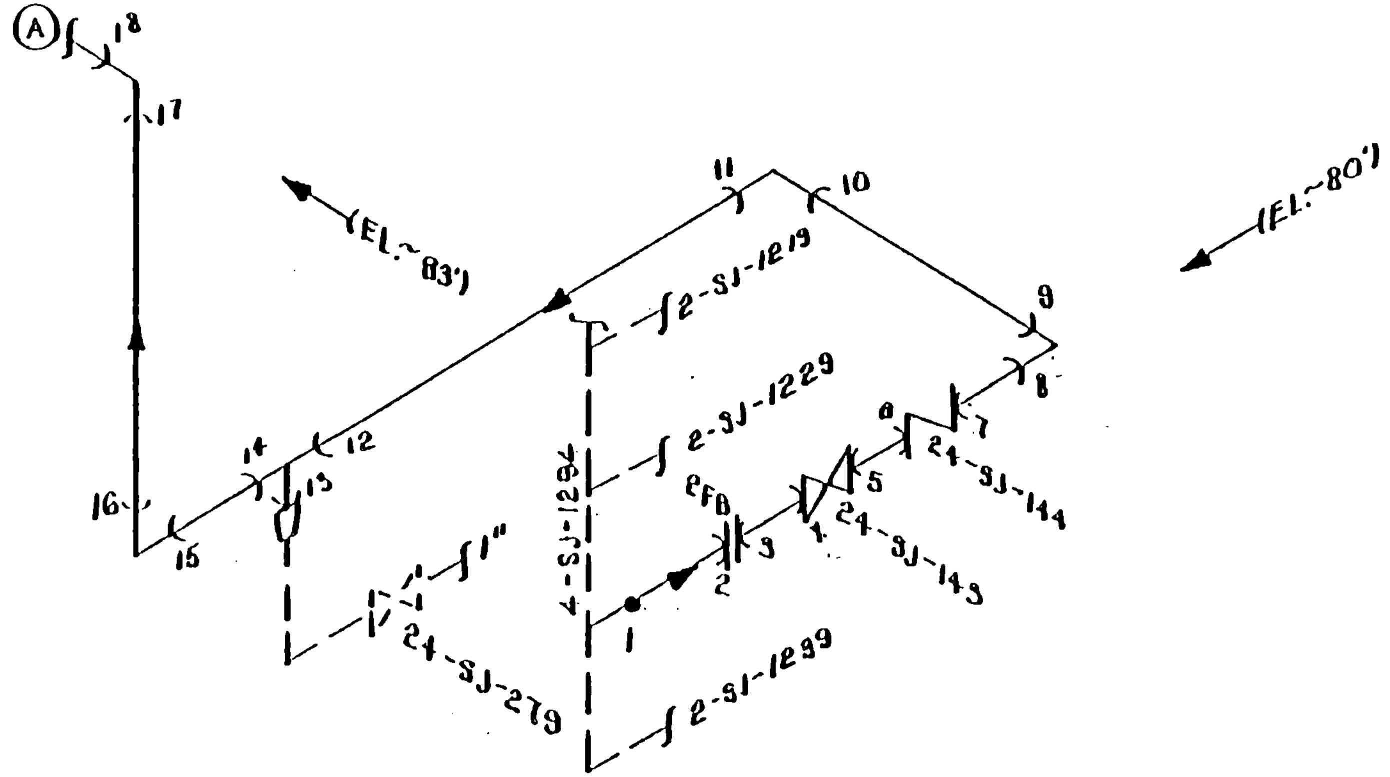


*3-SS-160-.451-30-SAM
3-SS-XX-.600-43-SAM

PSE&G No: 3"-2SJ1012	PSE&G Dwg: RH-2-3 Sht. 5	Thickness: .438"(160), .600"(XX)
SwRI No: 3-SJ-1292	Basic Cal. Blk.: See Above*	Figure: A-88



3-SJ-1292
FIG. A-88A



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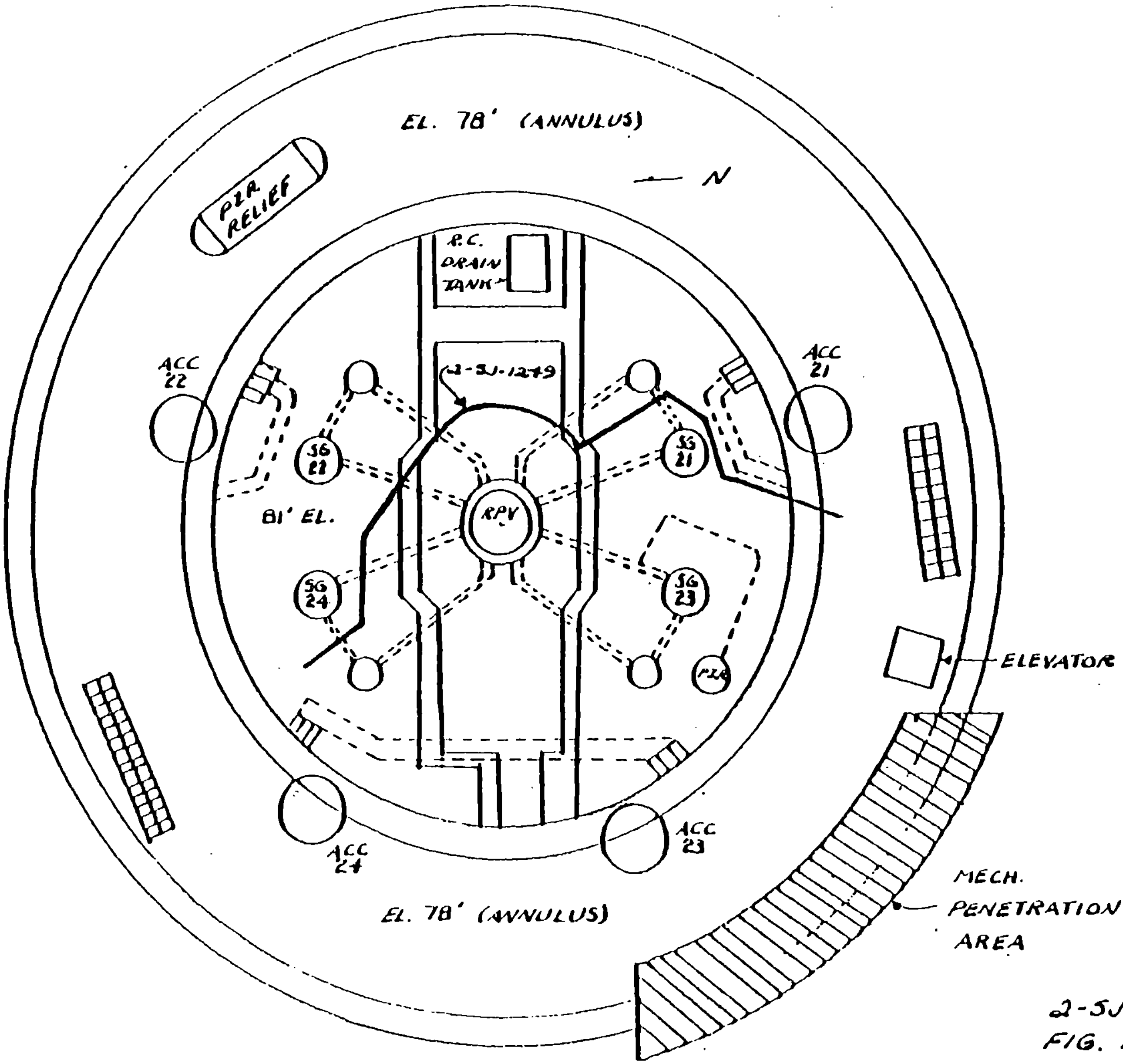
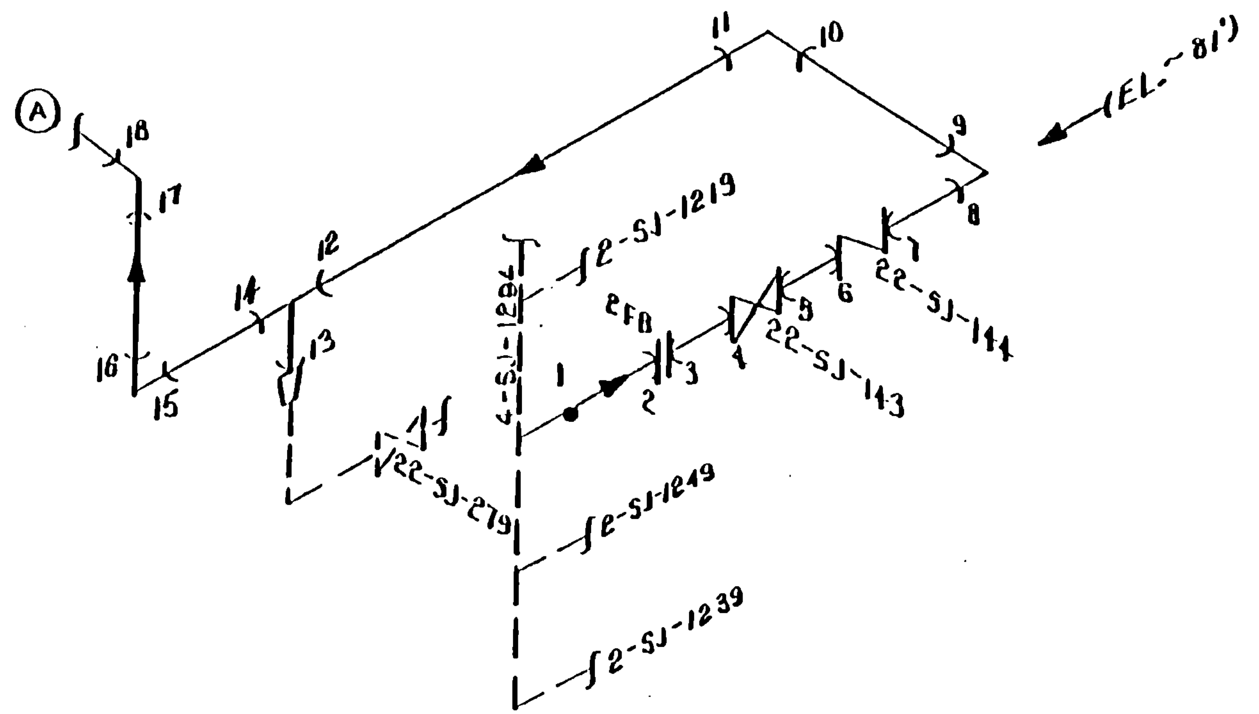
PSB&G No: 2"-2SJ1116	PSB&G Dwg: RH-2-3 Sht. 13814	Thickness: 0.344"
SwRI No: 2-SJ-1249	Basic Cal. Blk.: 2-SS-160-.330-39-SAH	Figure: A-89



2-SJ-1249
FIG. A-89A



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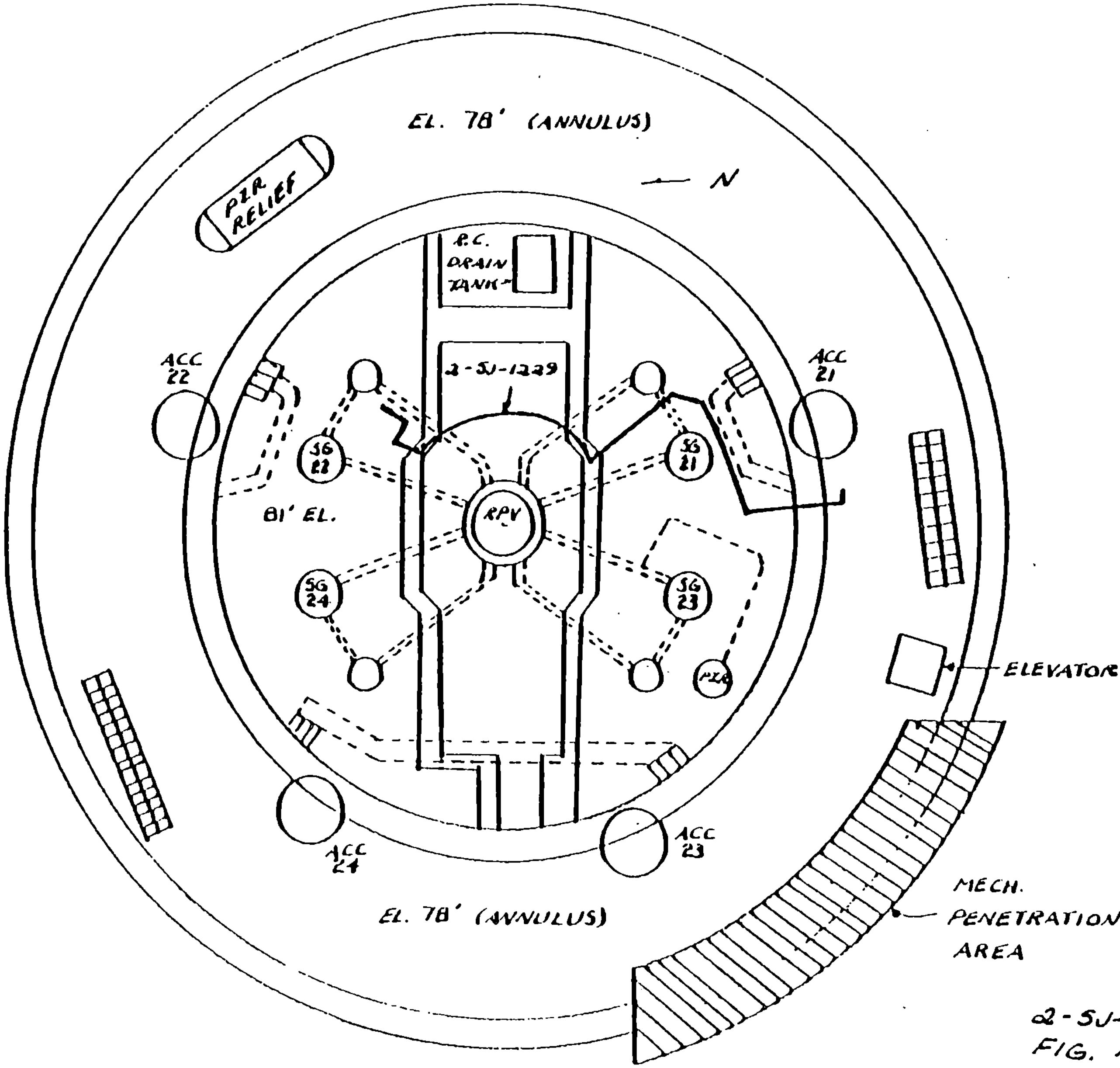
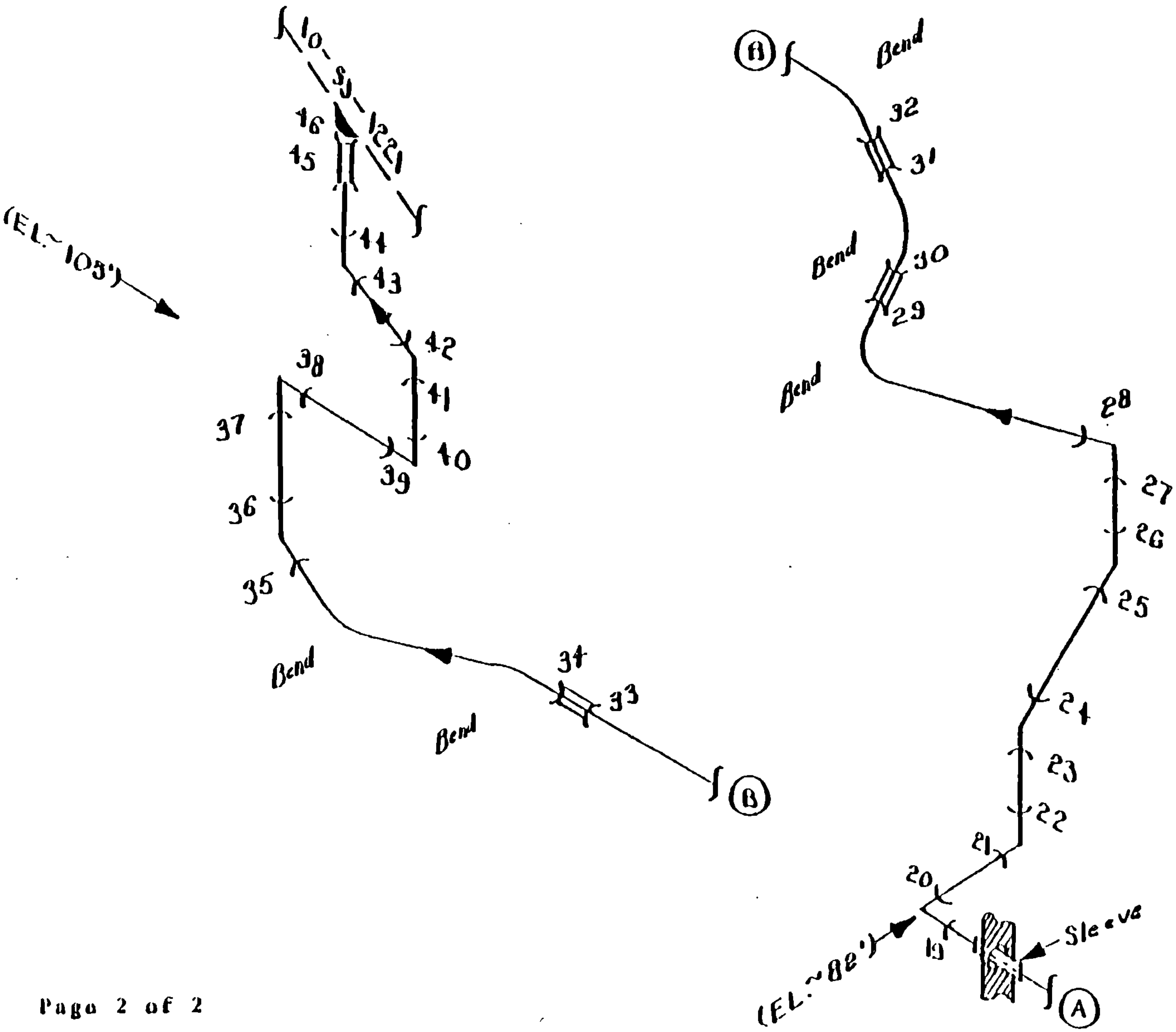
PSB&G No: 2"-2SJ1115	PSB&G Dwg: RH-2-3 Sht. 13&14	Thickness: 0.344"
SwRI No: 2-SJ-1229	Basic Cal. Blk.: 2-SS-160-.330-39-SAM	Figure: A-94



2-SJ-1229
FIG. A-94A



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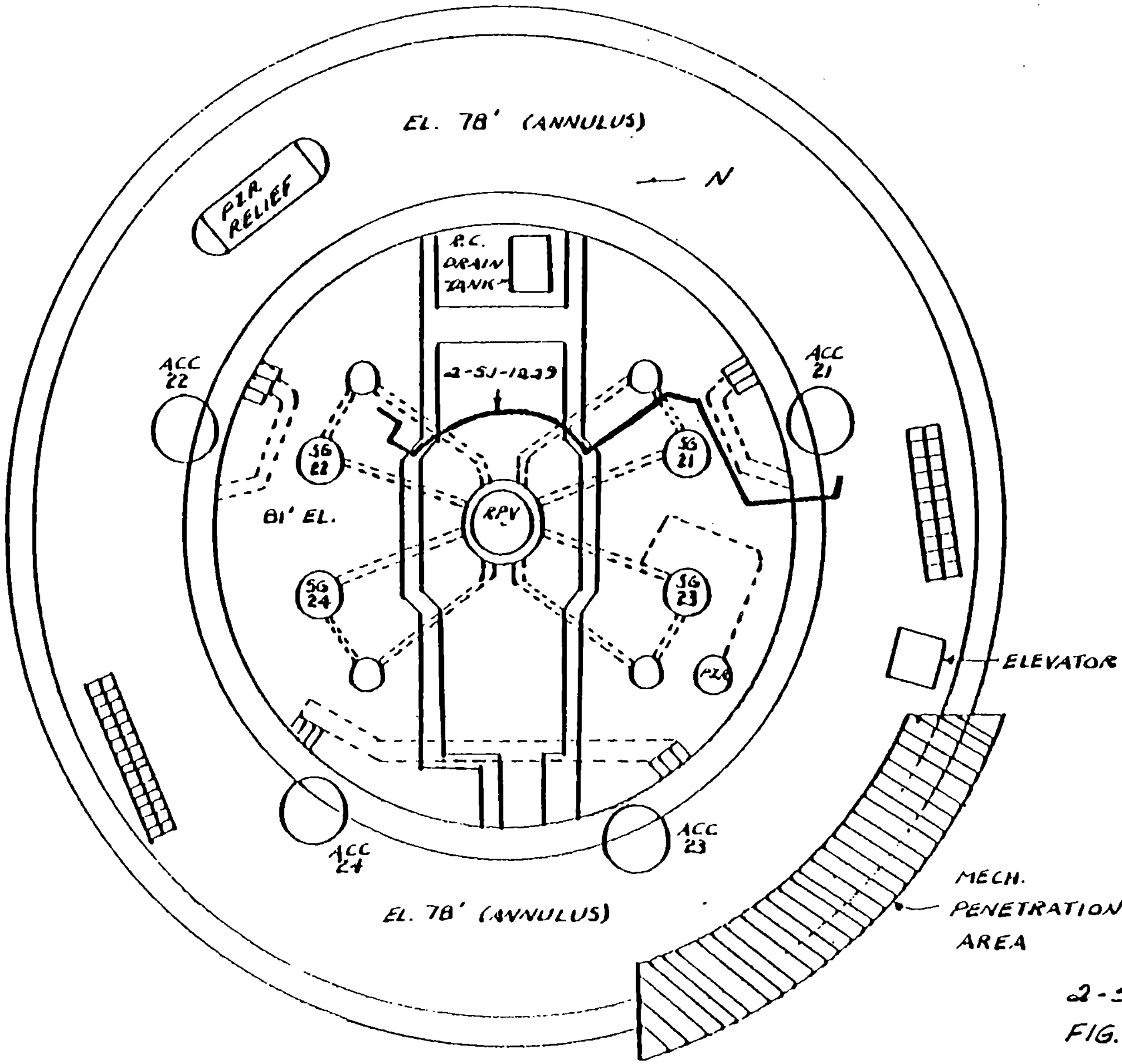
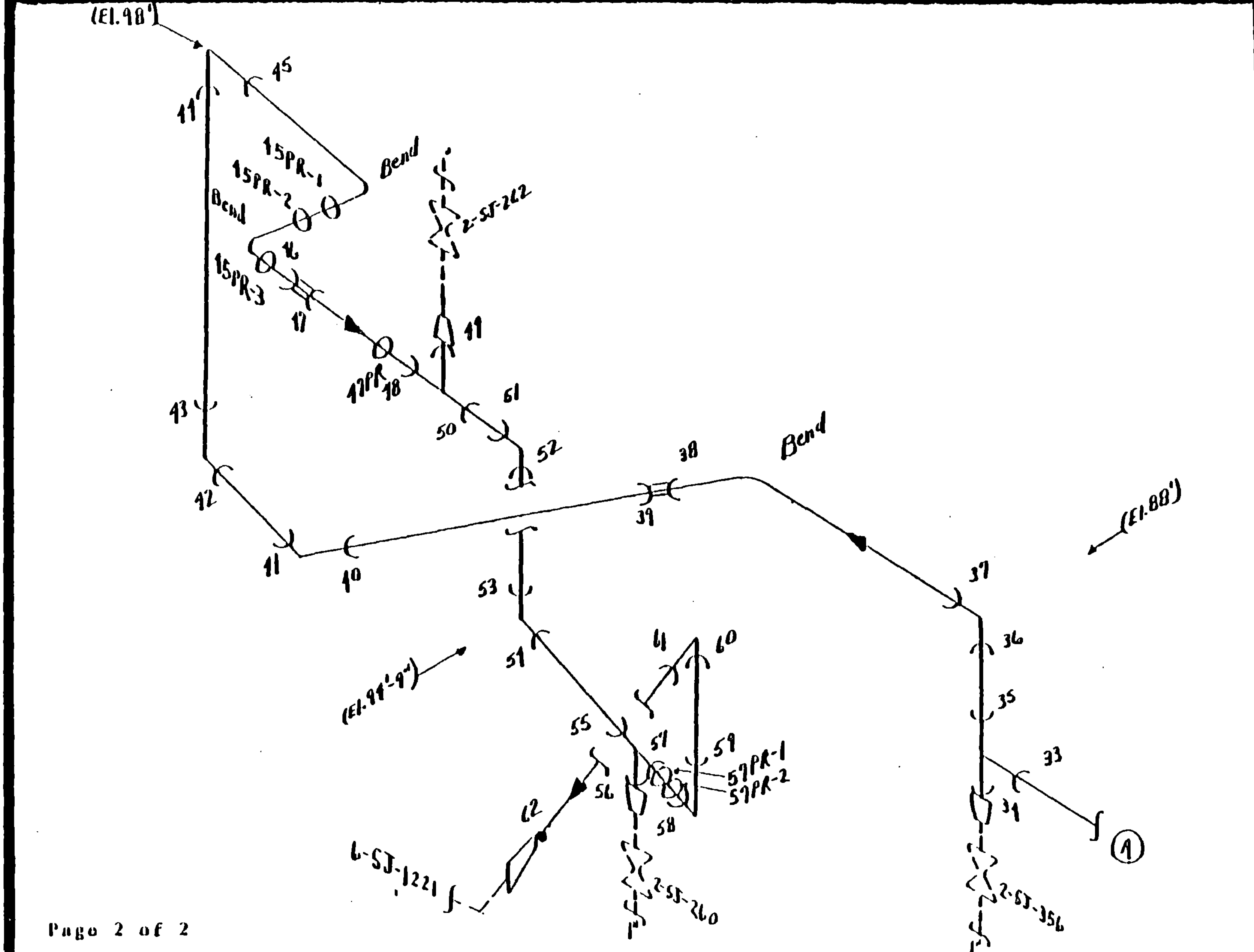
PSR&G No: 2"-2SJ1115	PSR&G Dwg: RH-2-3 Sht. 13&14	Thickness: 0.344"
SwRI No: 2-SJ-1229	Basic Cal. Blk.: 2-SS-160-.330-39-SAM	Figure: A-95



2-SJ-1229
FIG. A-95A



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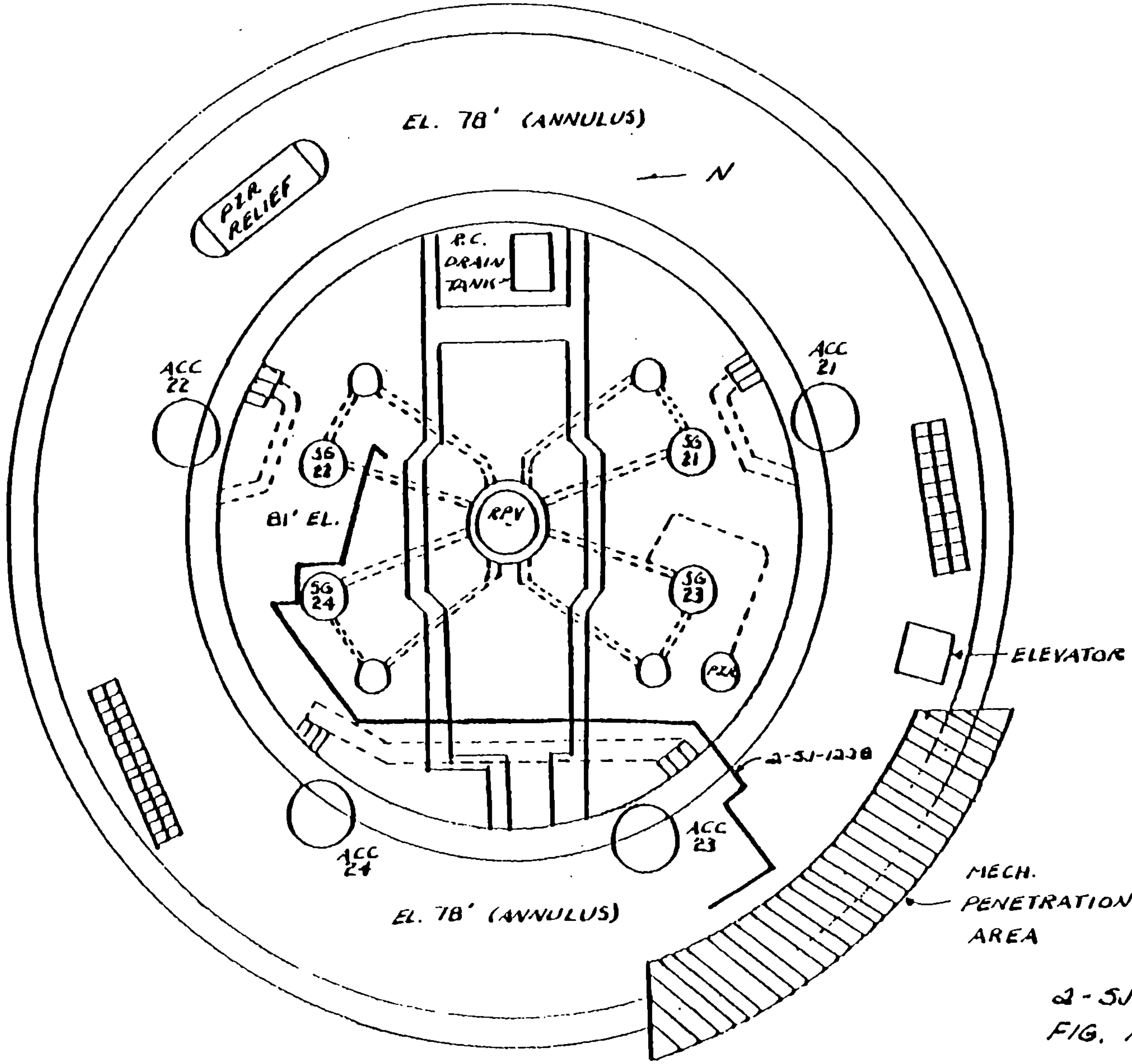
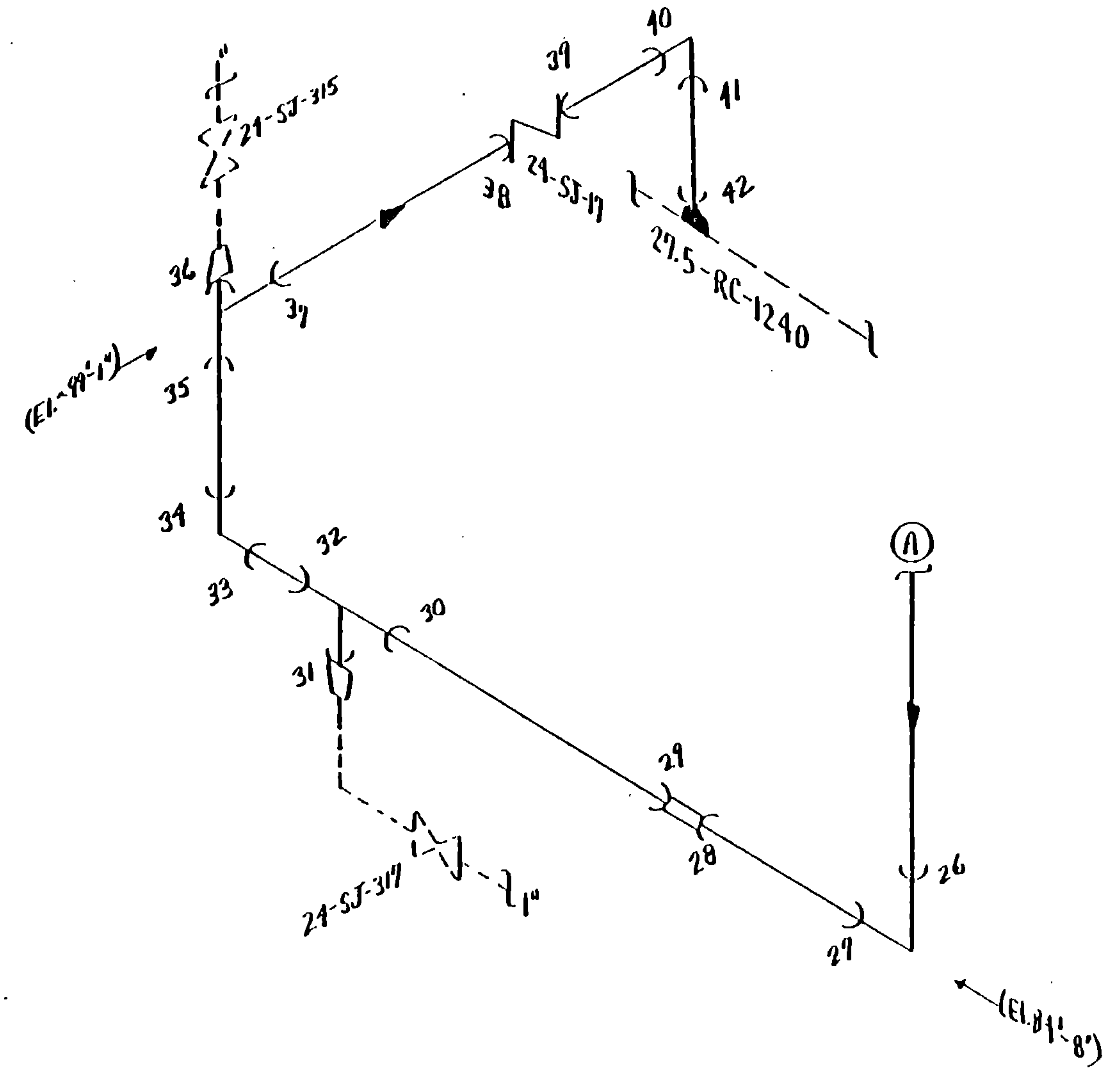
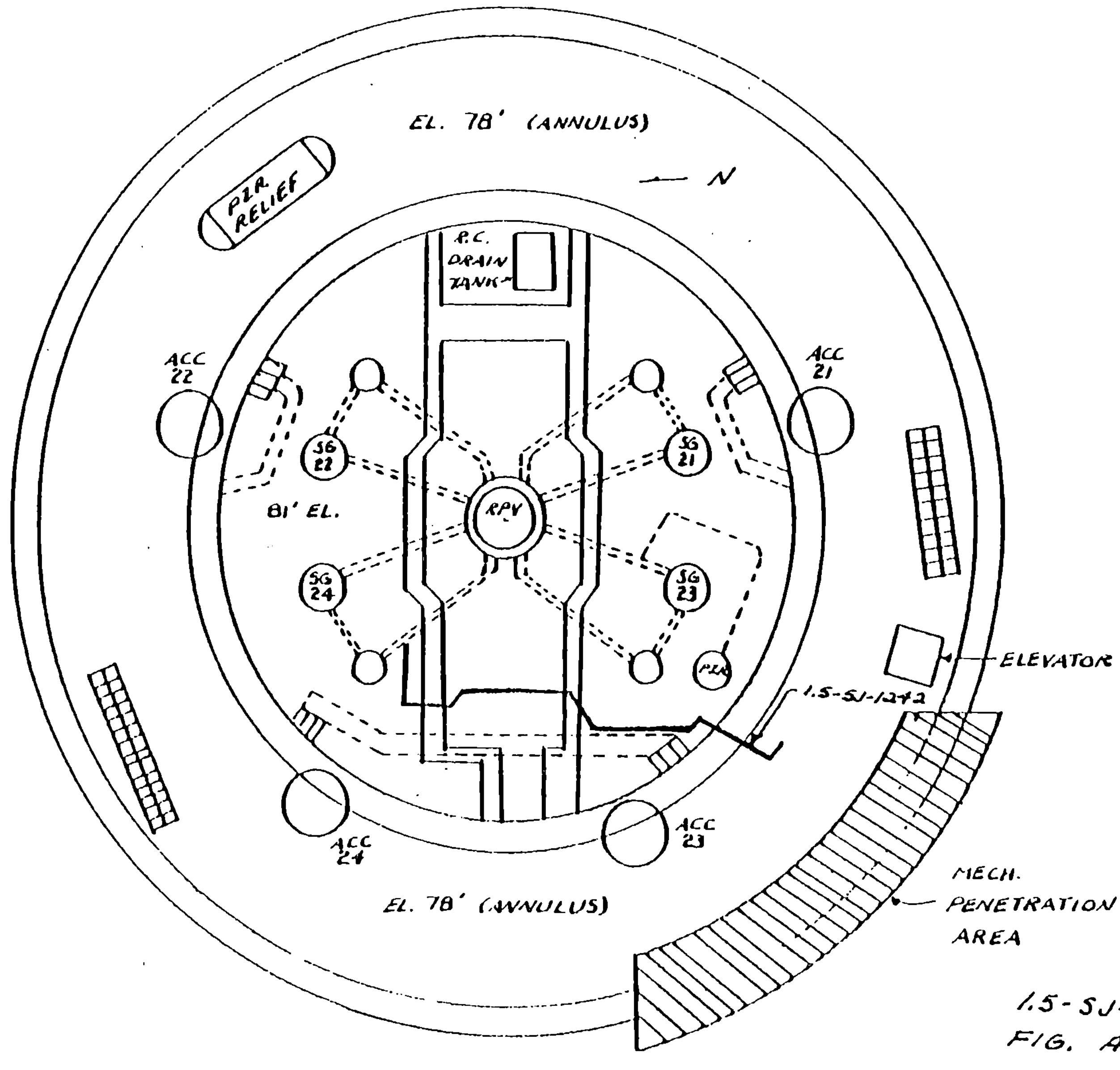
PSE&G No: 2"-2SJ1047	PSE&G Dwg: RH-2-3 Sht. 19	Thickness: 0.344"
SwRI No: 2-SJ-1228	Basic Cal. Blk.: 2-SS-160-.330-39-SAM	Figure: A-97



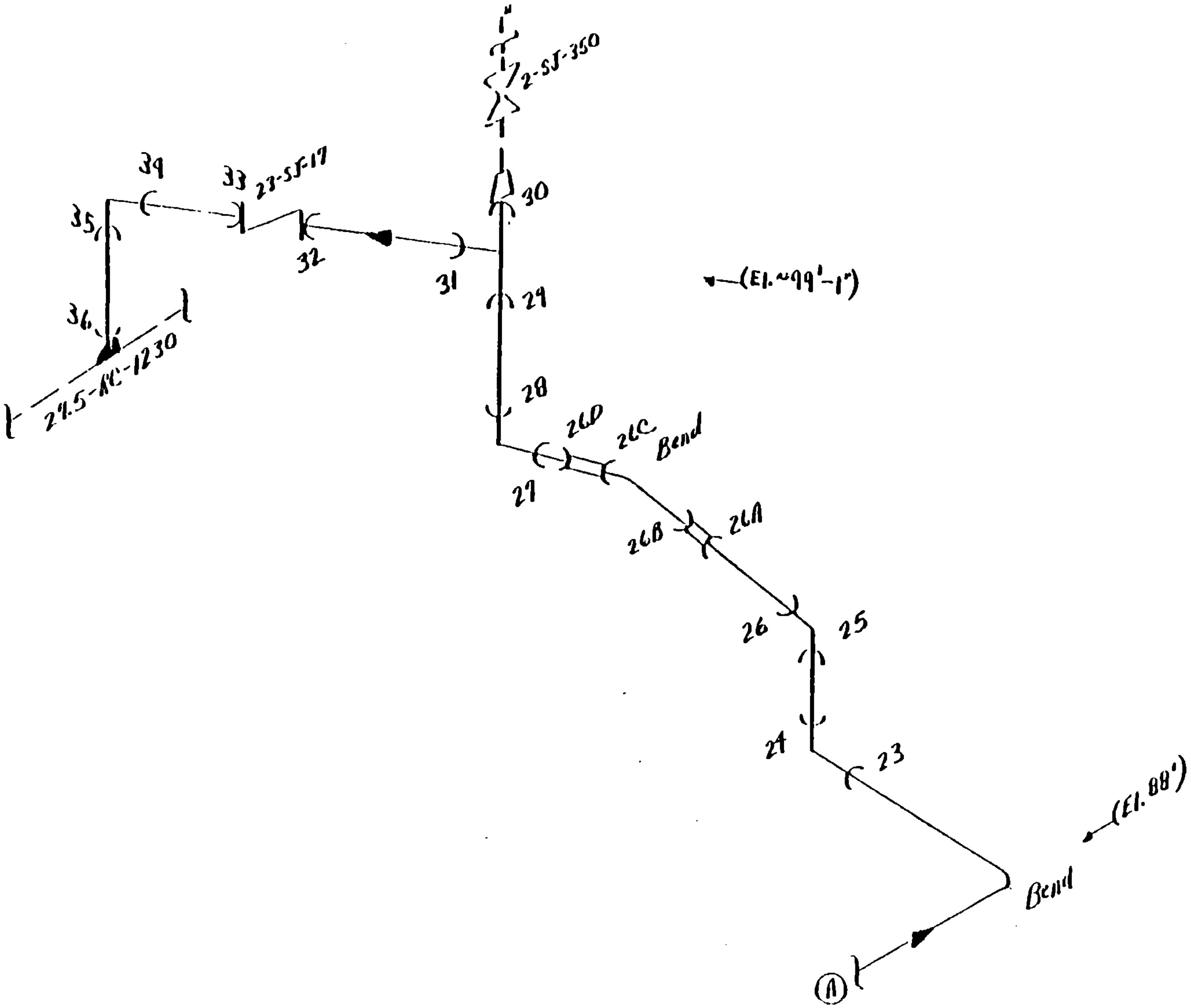
2-SJ-1228
FIG. A-97A



PSE&G No: 1-1/2"-2SJ1016	PSE&G Dwg: RH-2-3 Sht. 7	Thickness: 0.281"
SwRI No: 1.5-SJ-1242	Basic Cal. Blk.: N/A	Figure: A-102



1.5-SJ-1242
FIG. A-102A



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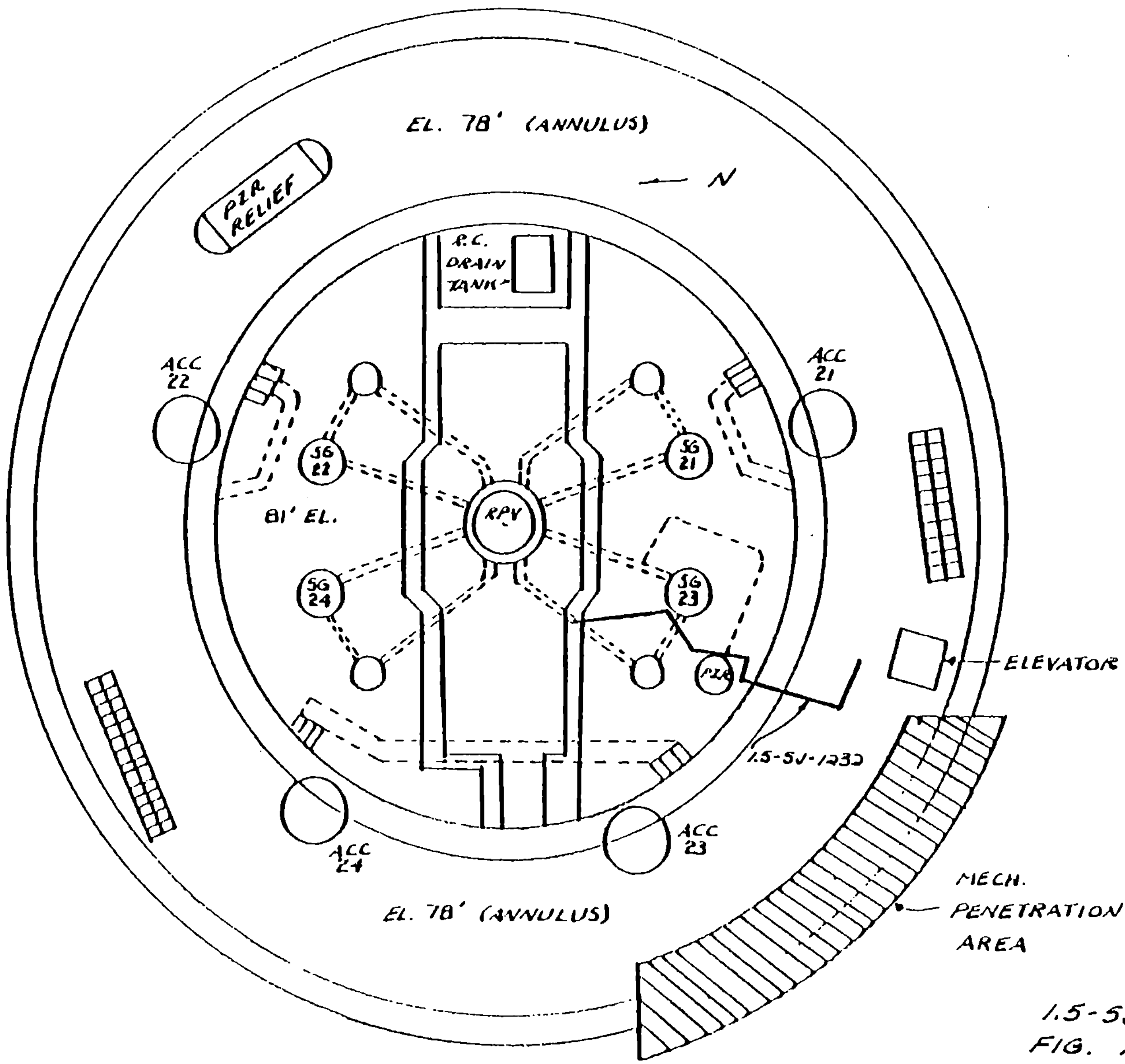
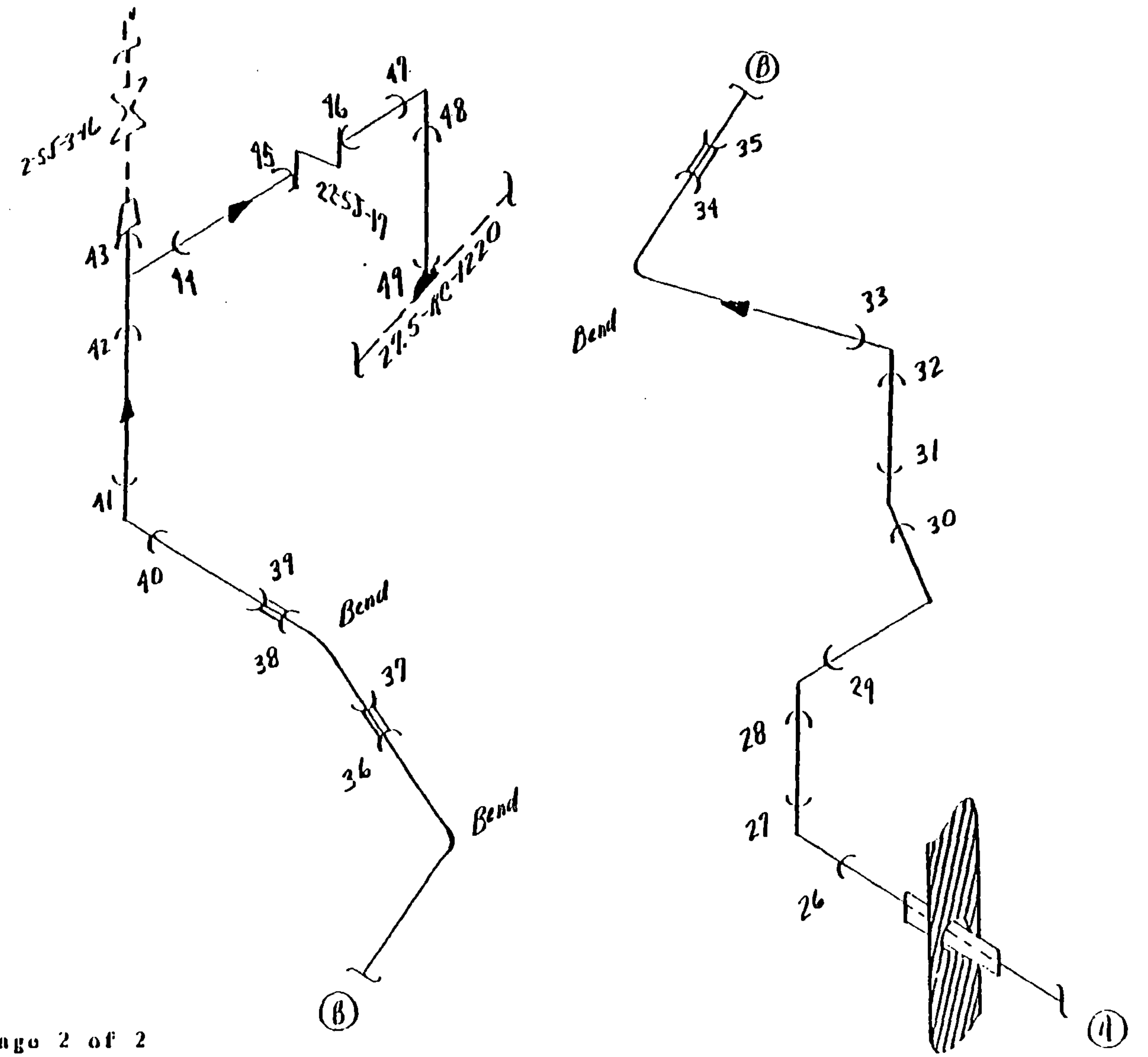
PSB&G No: 1-1/2"-2SJ1015	PSB&G Dwg: RH-2-3 Sht. 8	Thickness: 0.281"
SwRI No: 1.5-SJ-1232	Basic Cal. Blk.: N/A	Figure: A-104



1.5-5J- 1232
FIG. A-104A



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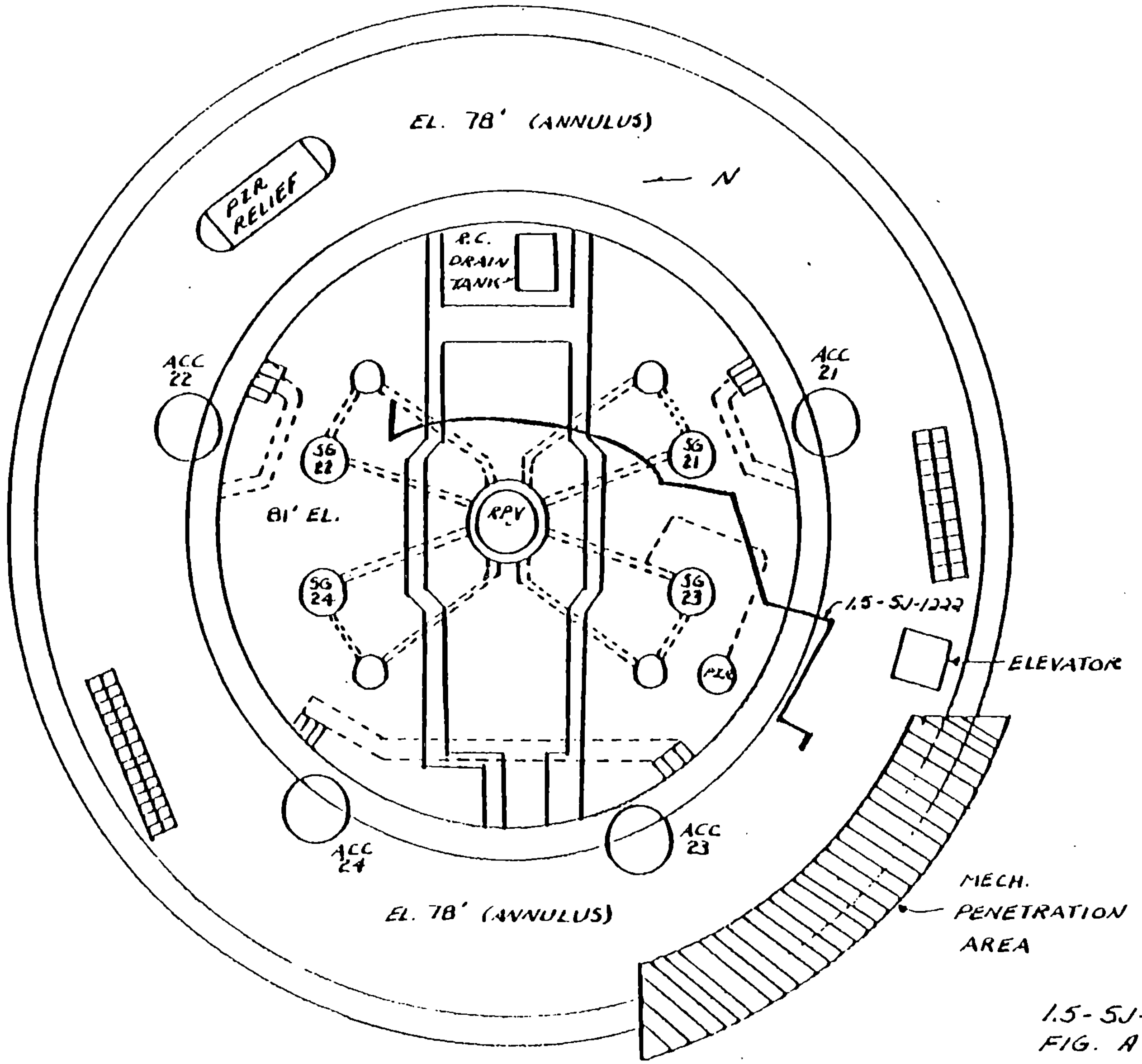
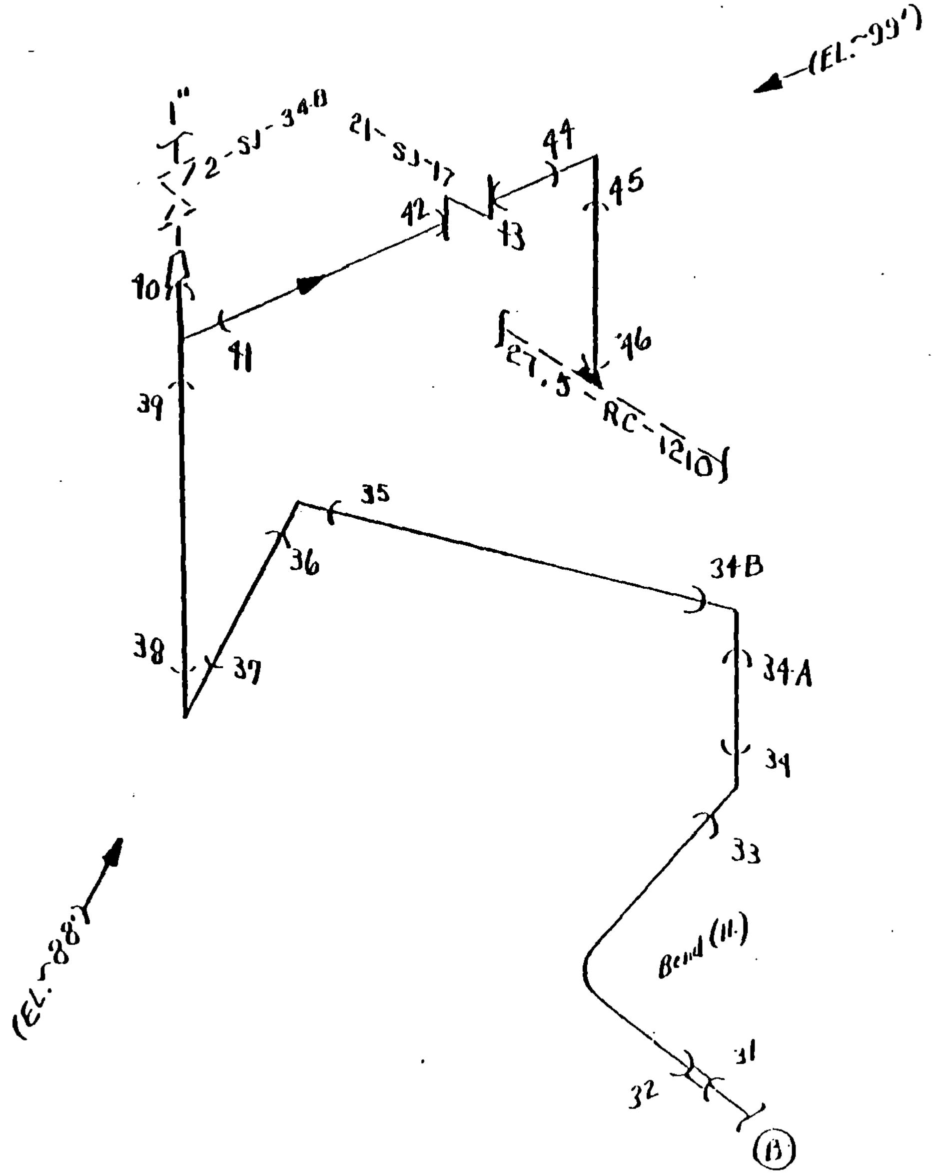
PSE&G No: 1-1/2"-2SJ1013	PSE&G Dwg: RH-2-3 Sht. 8	Thickness: 0.281"
SwRI No: 1.5-SJ-1222	Basic Cal. Blk.: N/A	Figure: A-106



1.5-SJ-1222
FIG. A-106A



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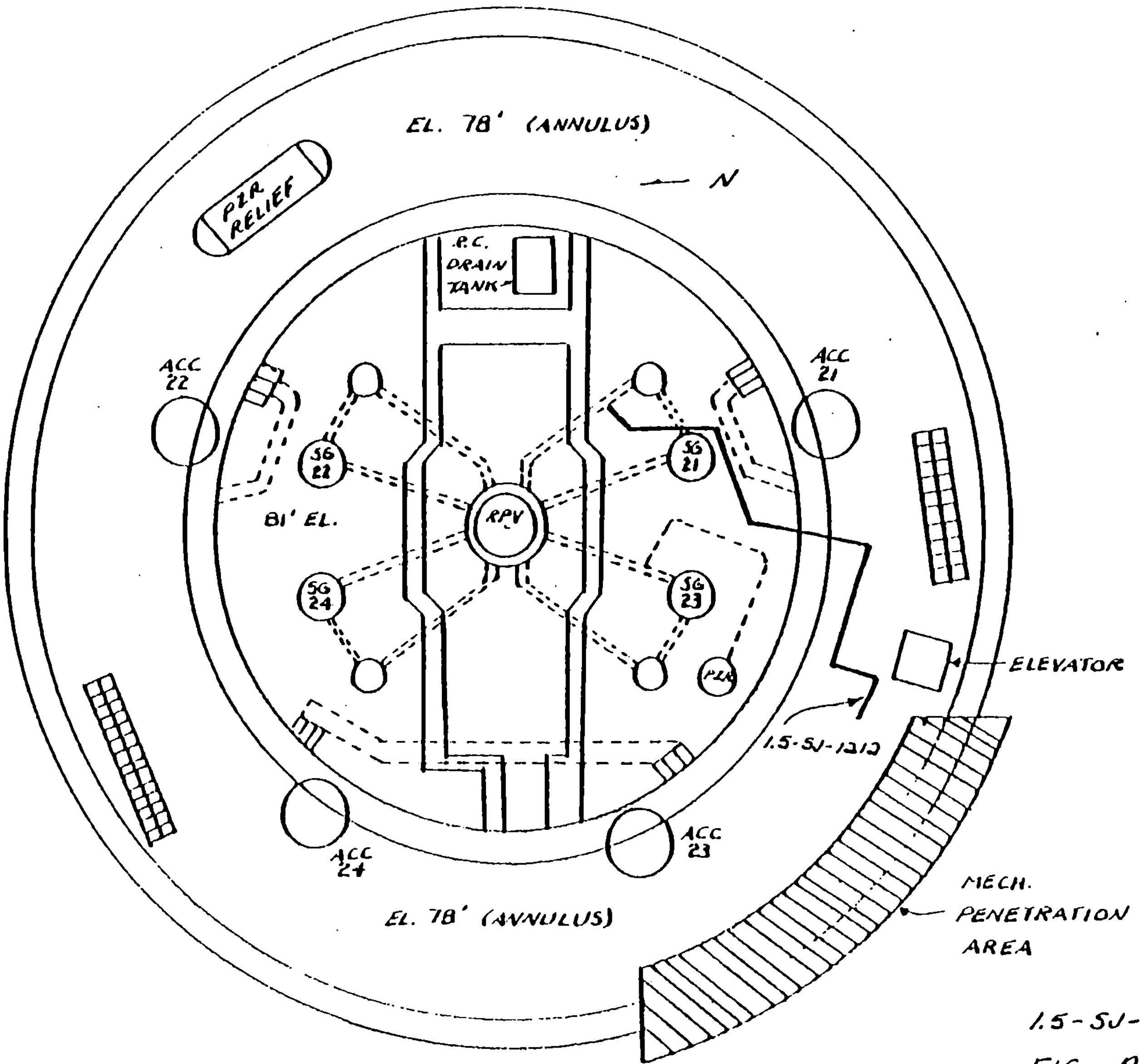
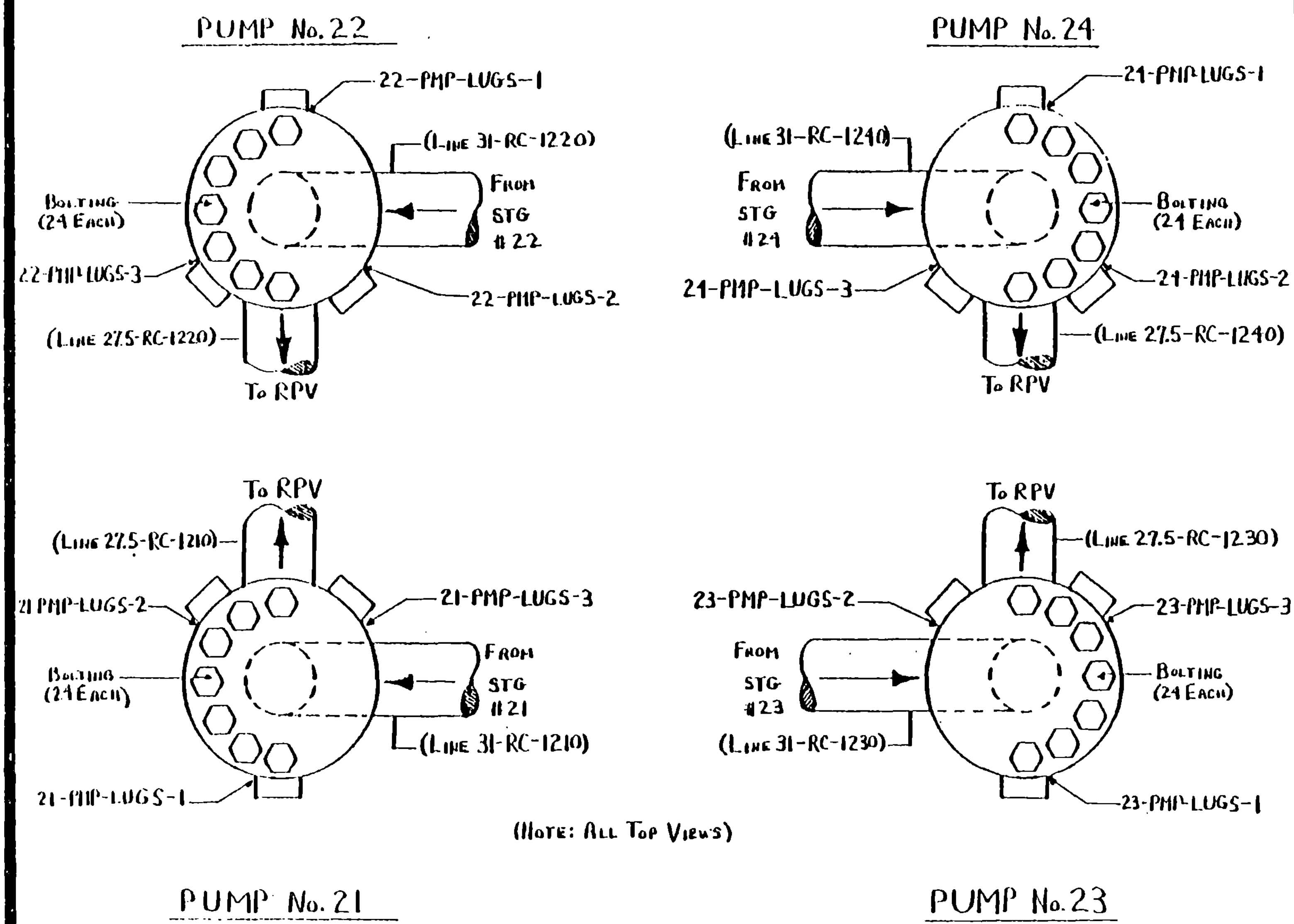
PSE&G No: 1-1/2"-2SJ1014	PSE&G Dwg: RH-2-3 Sht. 11	Thickness: 0.281"
SwRI No: 1.5-SJ-1212	Basic Cal. Blk.: N/A	Figure: A-108



1.5-SJ-1212

FIG. A-108A



PSE&G No: Reactor Coolant Pumps	PSE&G Dwg: N/A (diagram only)	Thickness: ________________
SWRI No: Reactor Coolant Pumps	Basic Cal. Blk.: 4.5-.75-8-CS-70-SAM	Figure: A-109

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APPENDIX B

WELD IDENTIFICATION DRAWINGS - CLASS 2

APPENDIX B

WELD IDENTIFICATION DRAWINGS - CLASS 2

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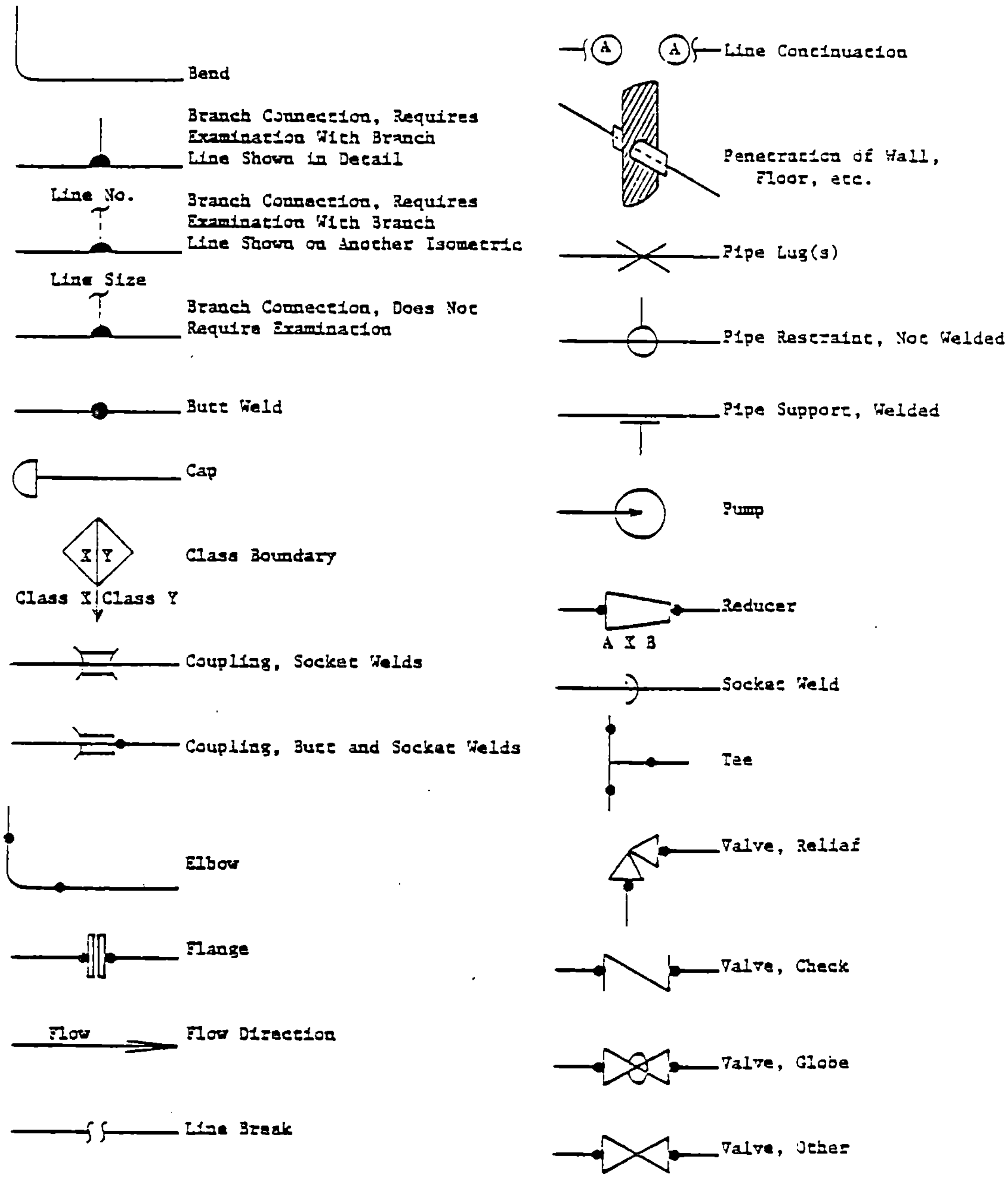


SYMBOLS FOR WELD IDENTIFICATION

Examination Area Identification System

1. Vessels

For Vessel examination area, the following format is used:

A-B-C

where: A is the number "2" and denotes Salem Unit 2 except for nozzles and Steam Generators. For nozzles, A is the same as the connecting line size. For Steam Generators, A is the same as the Steam Generator number.

where: B denotes the vessel, as follows:

PZR	-	Pressurizer
PRN	-	Pressurizer Nozzles
RPV	-	Reactor Pressure Vessel
RPVCH	-	Reactor Presure Vessel Closure Head
RCN	-	Steam Generator Nozzles
STG	-	Steam Generator

where: C is a unique number or letter identifying the examination area. For RPV circumferential, meridional, and longitudinal welds, C is the same number that Westinghouse assigned to the weld. C ends in IRS for inside radius section examination areas.

Examples:

2-RPV-2042A

- 2042A — Unique Number (Westinghouse number)
- RPV — Reactor Pressure Vessel
- 2 — Unit 2

21-STG-25

- 25 — Unique Number
- STG — Steam Generator
- 21 — Steam Generator No. 21

4-PRN-1203-IRS

- IRS — Inside Radius Section
- 1203 — Unique Number
- PRN — Pressurizer Nozzle
- 4 — Nozzle for 4-in. Line

2. Piping

For piping welds, the following format is used:

AA-BB-CDEE-F-(-G)

where: AA denotes the nominal pipe diameter of the line.

where: BB denotes the piping system associated with the line (determined by PSE&G valve nomenclature), as follows:

BF - Steam Generator Feed
CS - Containment Spray
CV - Chemical and Volume Control System
MS - Main Steam
PR - Pressurizer Relief
PS - Pressurizer System
RC - Reactor Coolant
RH - Residual Heat Removal
SJ - Safety Injection

where: C has the following options:

1 - Class 1 examination areas
2 - Class 2 examination areas

where: D is the integer 2 and denotes Salem Unit 2.

where: EE is two integers asigned to assure uniqueness. For the Main Reactor Coolant Loops, the first integer correlates with the loop number and the second integer is zero.

where: F is assigned to assure uniqueness and to designate the type of weld as follows:

a. If only a one- or two-digit integer appears, this indicates a circumferential weld. The welds are numbered consecutively in the direction of flow. Where the direction of flow is ambiguous, a flow direction is assumed.

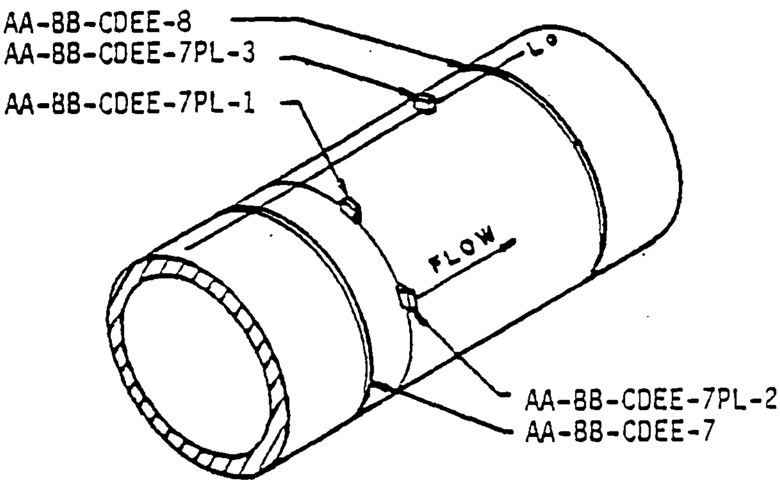
b. For other than circumferential welds, except branch connections, two letters are added to the circumferential weld number which either intersects the weld (in the case of the longitudinal welds) or is upstream from the component, as follows:

FB - Flange Bolting
LU - Longitudinal Seam Weld Extending Upstream
LD - Longitudinal Seam Weld Extending Downstream
PL - Pipe Lug (Welded)
PS - Pipe Support (Welded)

SC - Support Component Portion of A Welded Pipe Support
PR - Non-Welded Pipe Restraint

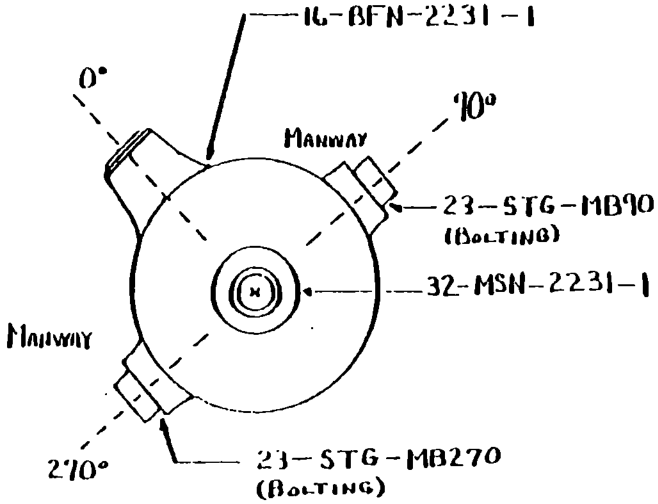
where: G is an integer assigned when there is more than one component [see (2) above] of one type or a longitudinal weld between successive circumferential welds. This number increases either sequentially from the upstream weld or clockwise from Lo, a standard reference location used for piping (see examples). On double seamed elbows, the weld located along the outside radius is denoted by the letter "O", and the weld located along the inside radius is denoted by the letter "I".

Example:

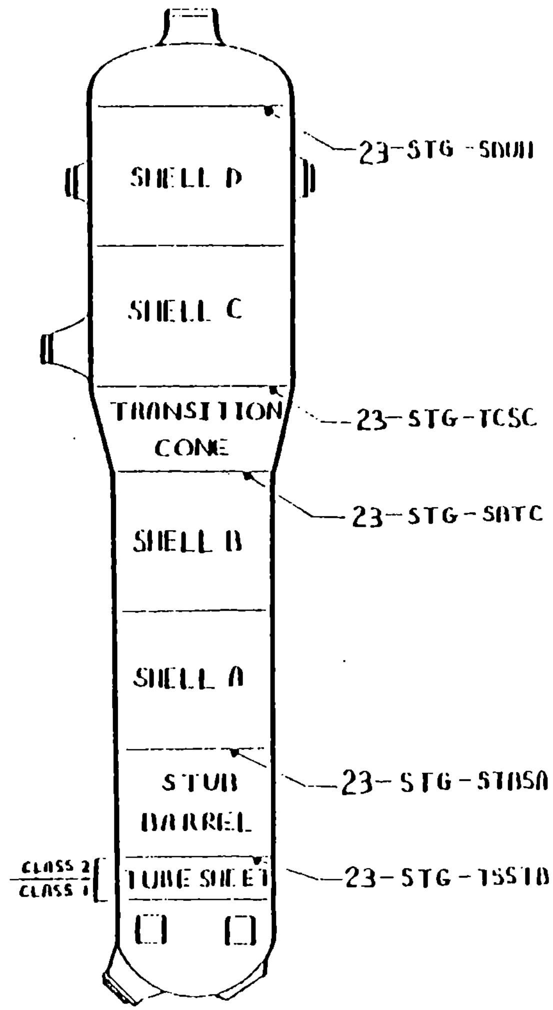


For branch connections exceeding 1-in. diameter nominal pipe size for Class 1 and 4-in. diameter nominal pipe size for Class 2, both the main run and branch line are identified and separated by a diagonal slash (/). To locate the branch connection, the upstream circumferential weld on the main run is also identified.

Example: 29-RC-1210-2/14-RH-1111 is the branch connection from the line 29-RC-1210 downstream from weld Number 2 which connects line 14-RH-1211.



UPPER HEAD



*PL-3-CS-51-SAM (Circ. Welds)
PL-CS-4.5-88-SAM (Nozzle-to-Vessel Welds)
1.250-8-B-CS-100-SAM

PSE&G No: Steam Generator #23	PSE&G Dwg: 1098J17(Watghse.,Fla.)	Thickness: _______________
SwRI No: Steam Generator #23	Basic Cal. Blk.: See Above*	Figure: B-2

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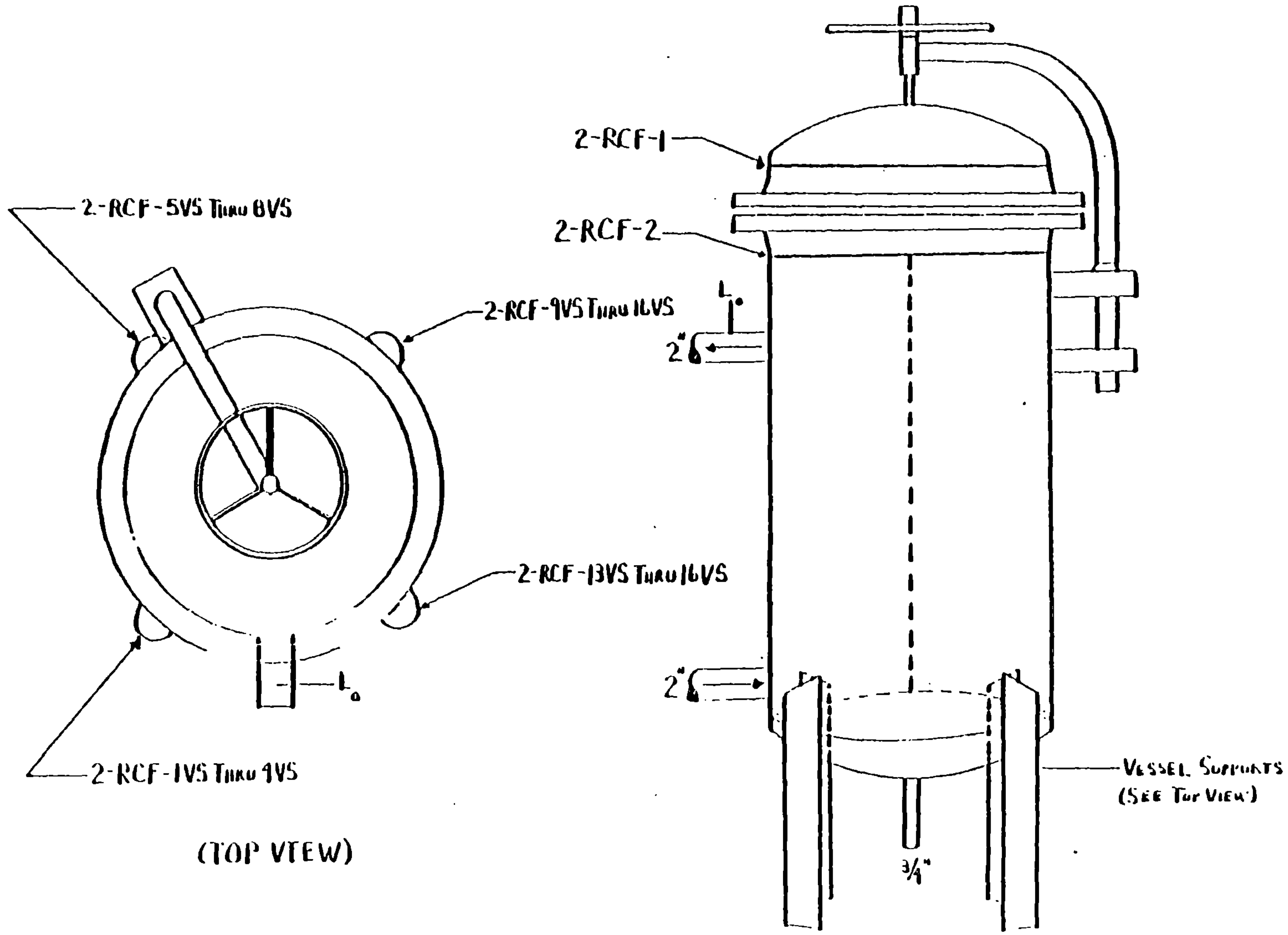

PSBAG No: Reactor Coolant Filter	PSBAG Dwg: --	Thickness: 14" dia. (vessel)
SwRI No: Reactor Coolant Filter	Basic Cal. Blk.: 14-SS-10-.250-96-SAM	Figure: B-9

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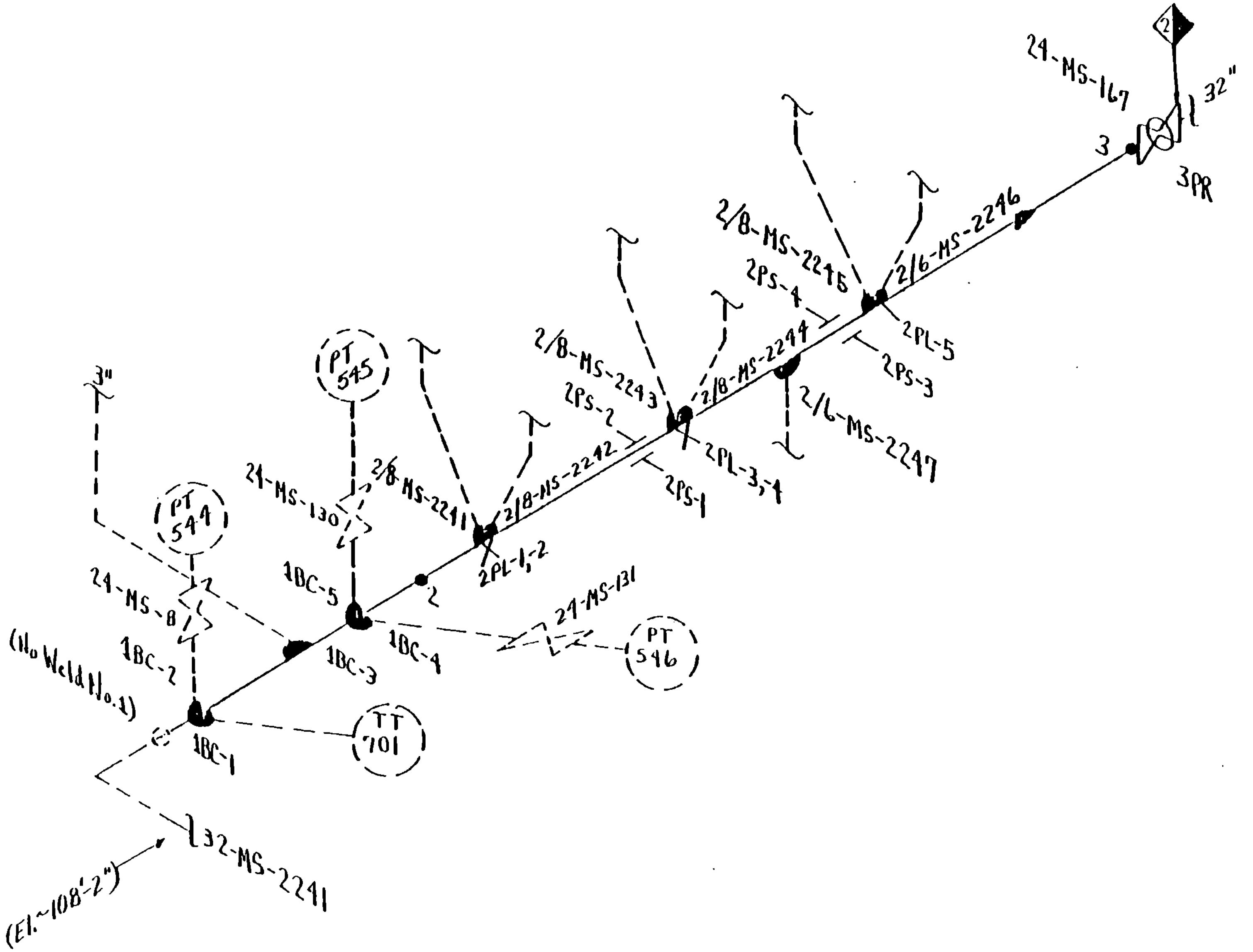
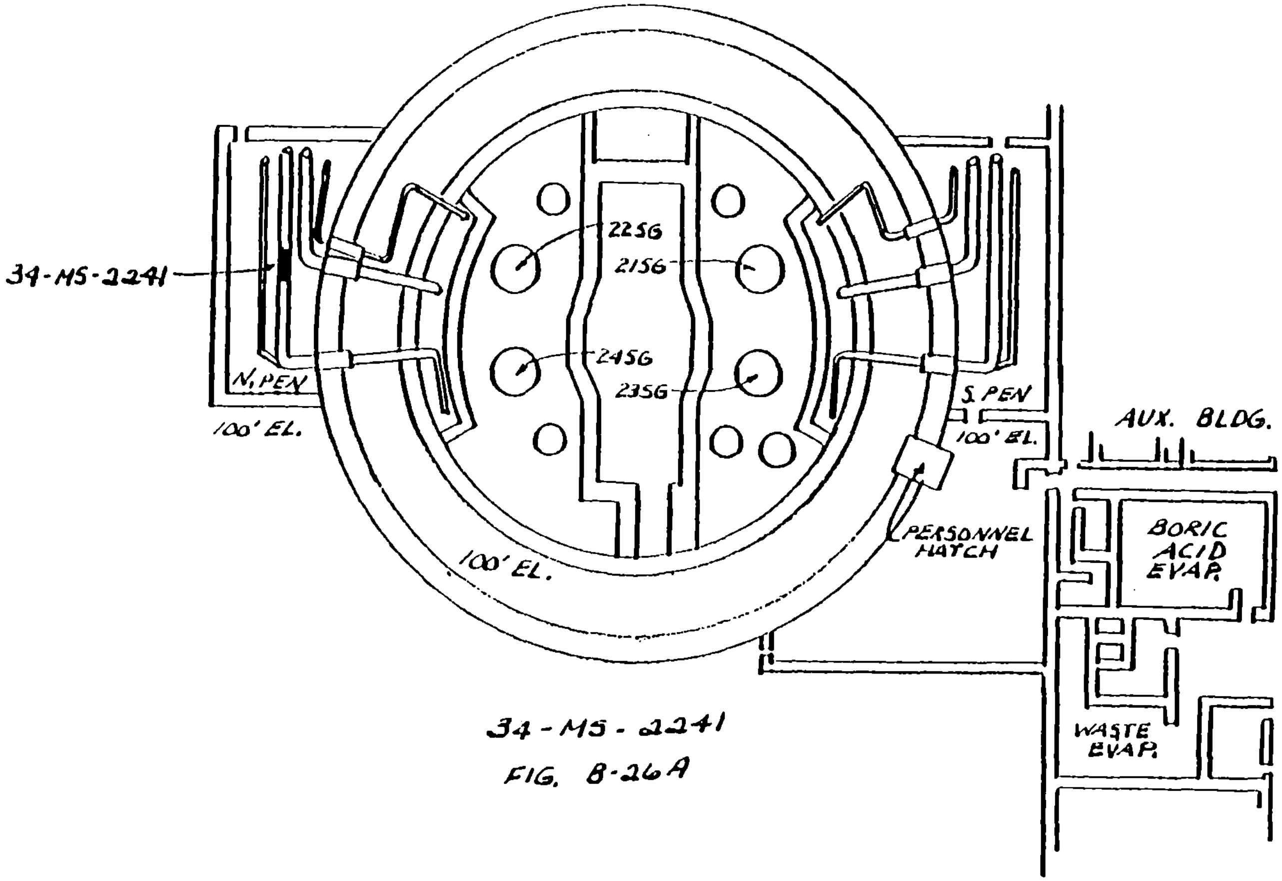
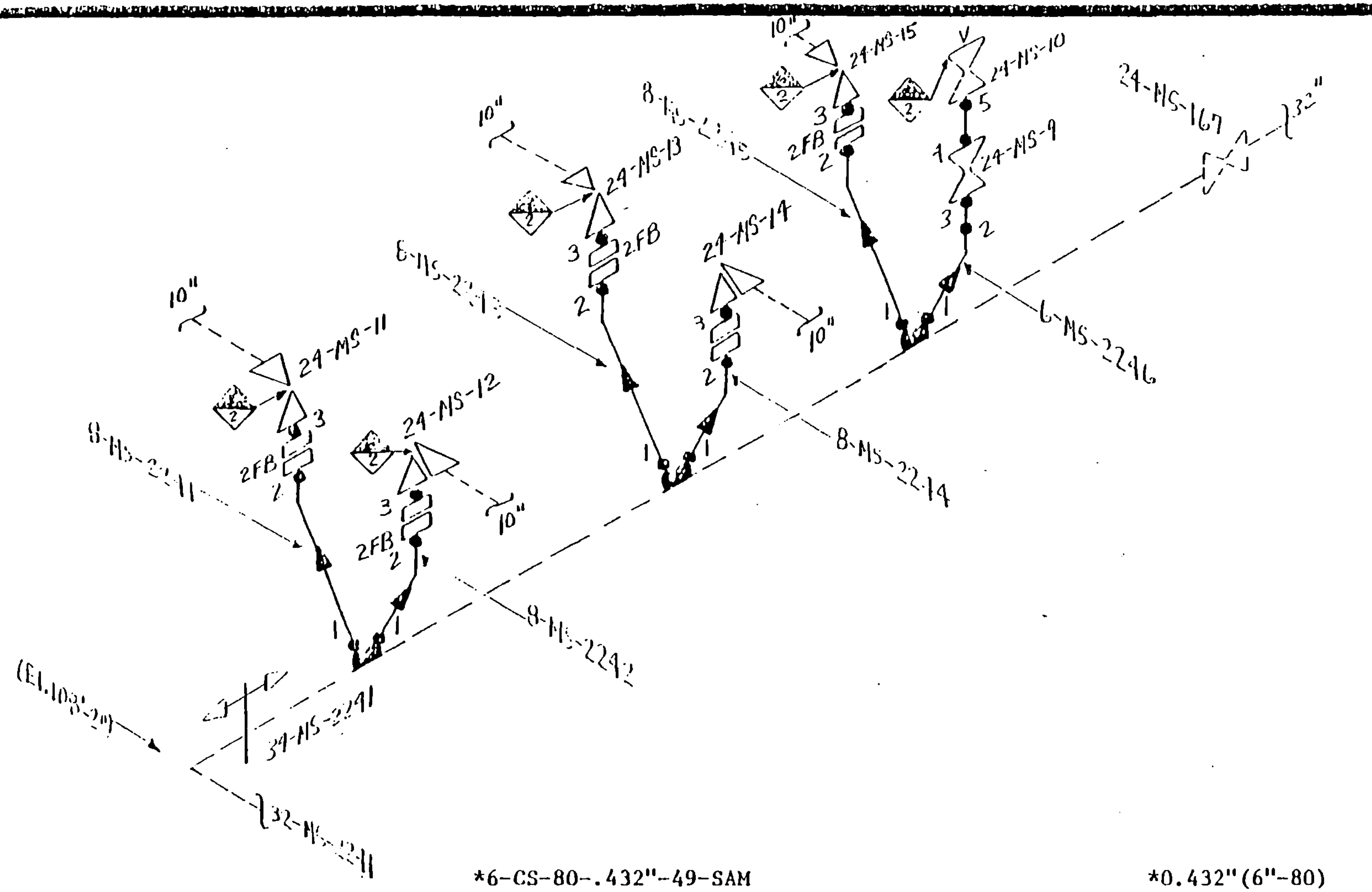
B-5



PSE&G No: 34"-2MS1020	PSE&G Dwg: MS-2-3 Sht. 5	Thickness: 3.314" Min. Wall
SwRI No: 34-MS-2241	Basic Cal. Blk.: 3x6-CS-26 (SwRI)/PL-3-CS-51-SAM	Figure: B-26



34 - MS - 2241
FIG. B-26A



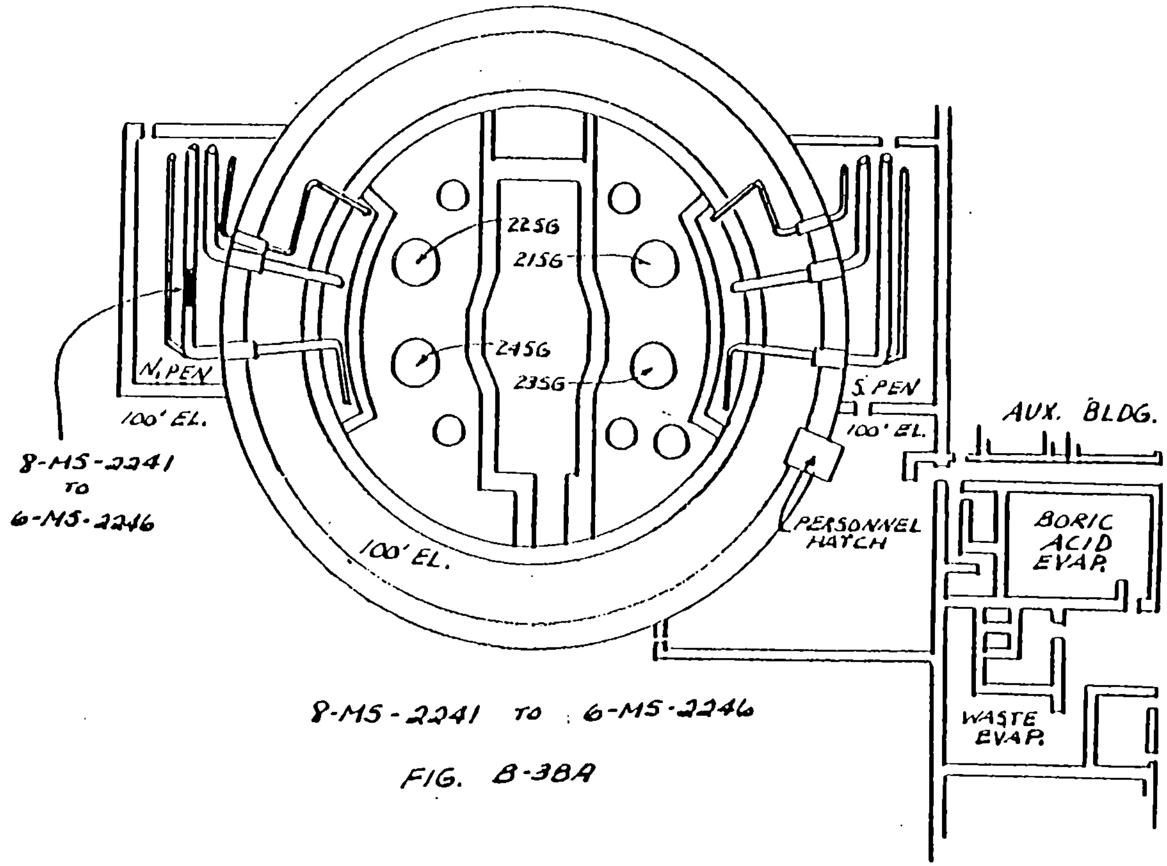
*6-CS-80-.432"-49-SAM
8-CS-160-.906-46-SAM
1.625-8-S-CS-89-SAM
1.625-8-N-CS-92-SAM

*0.432"(6"-80)
0.906"(8"-160)
1.625"(Studs)
1.625"(Nuts)

*PSE&G No:	8"-2MS1155	8"-2MS1158	8"-2MS1161	8"-2MS1164	8"-2MS1167	6"-2MS1492
*SwRI No:	8-MS-2241	8-MS-2242	8-MS-2243	8-MS-2244	8-MS-2245	6-MS-2246

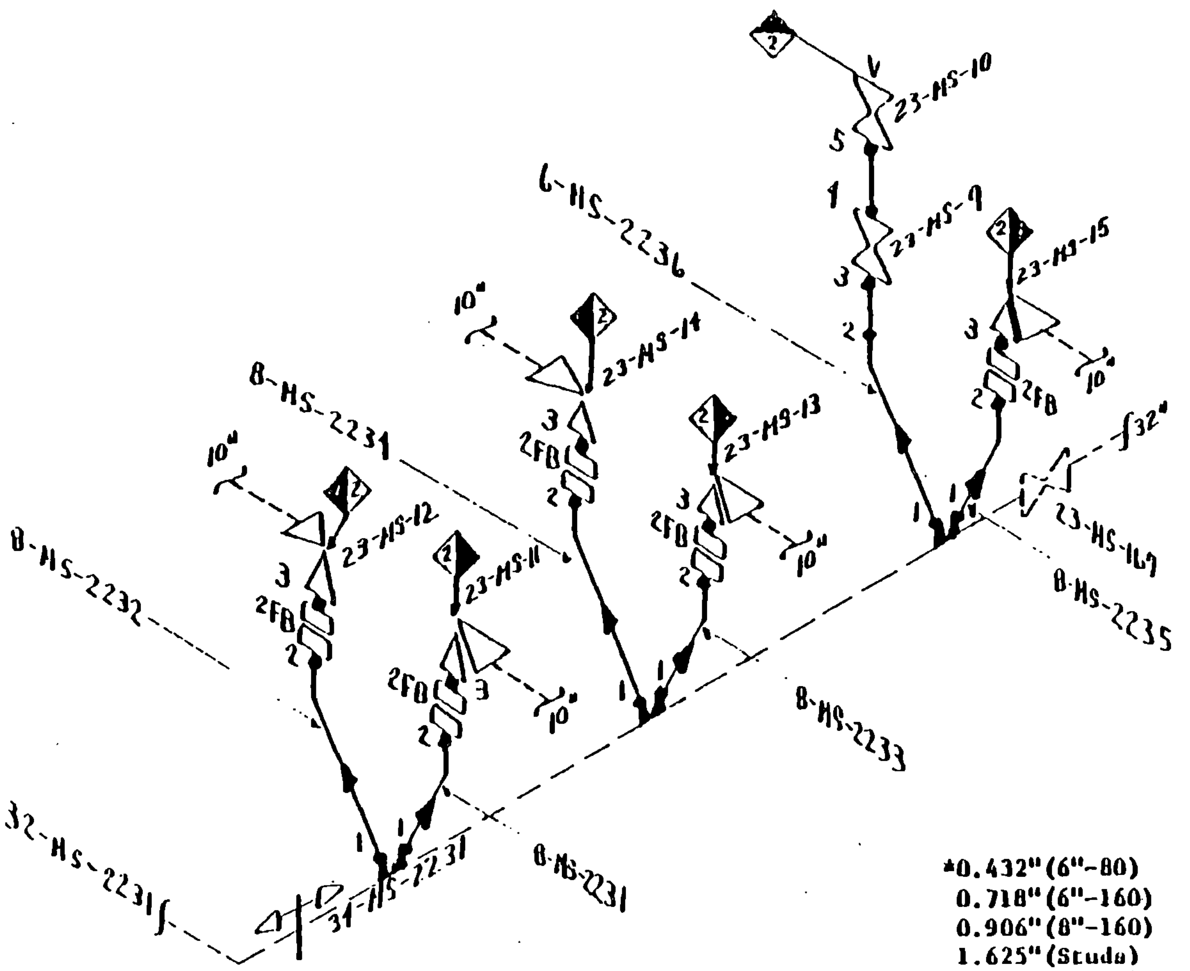
11/86

PSE&G No: See Above*	PSE&G Dwg: MS-2-3 Sht. 5	Thickness: See Above*
SwRI No: See Above*	Basic Cal. Blk.: See Above*	Figure: B-38



8-MS-2241 TO 6-MS-2246

FIG. B-38A

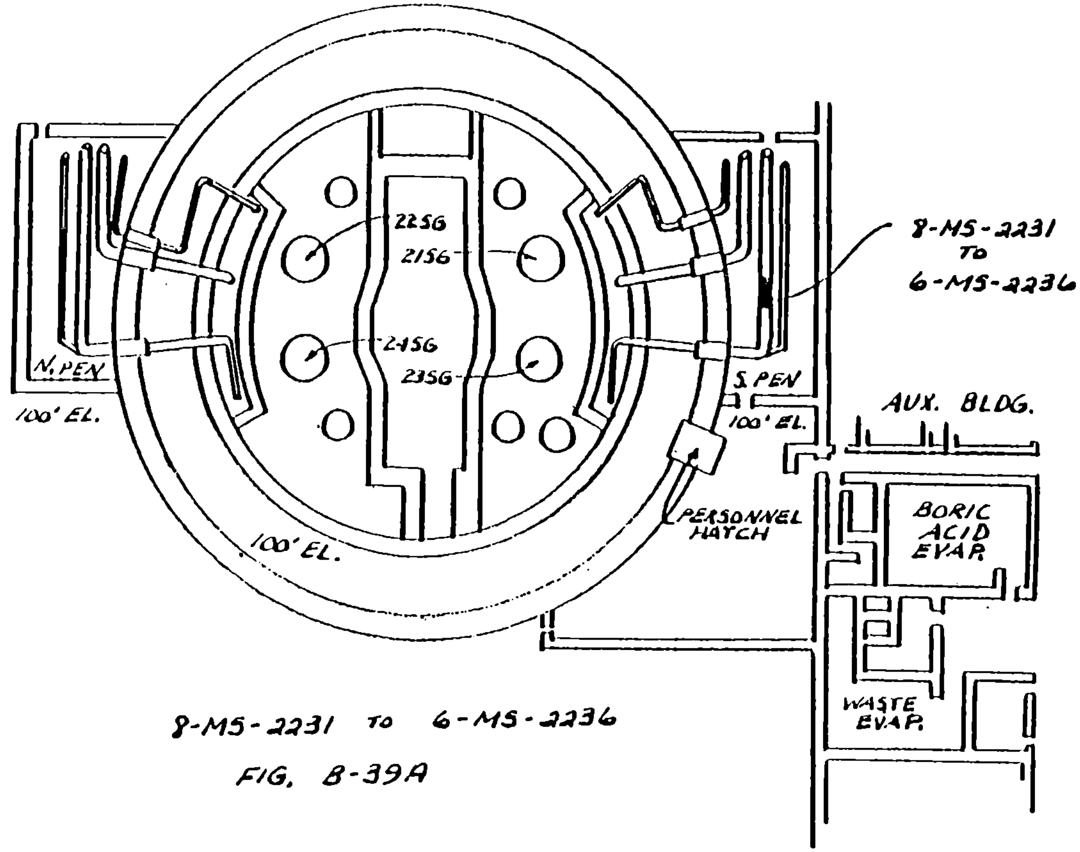


*6-CS-80-.432"-49-SAM
6-CS-160-.718-69-SAM
8-CS-160-.906-46-SAM
1.625-8-S-CS-89-SAM
1.625-8-S-CS-92-SAM

*0.432"(6"-80)
0.718"(6"-160)
0.906"(8"-160)
1.625"(Studs)
1.625"(Nuts)

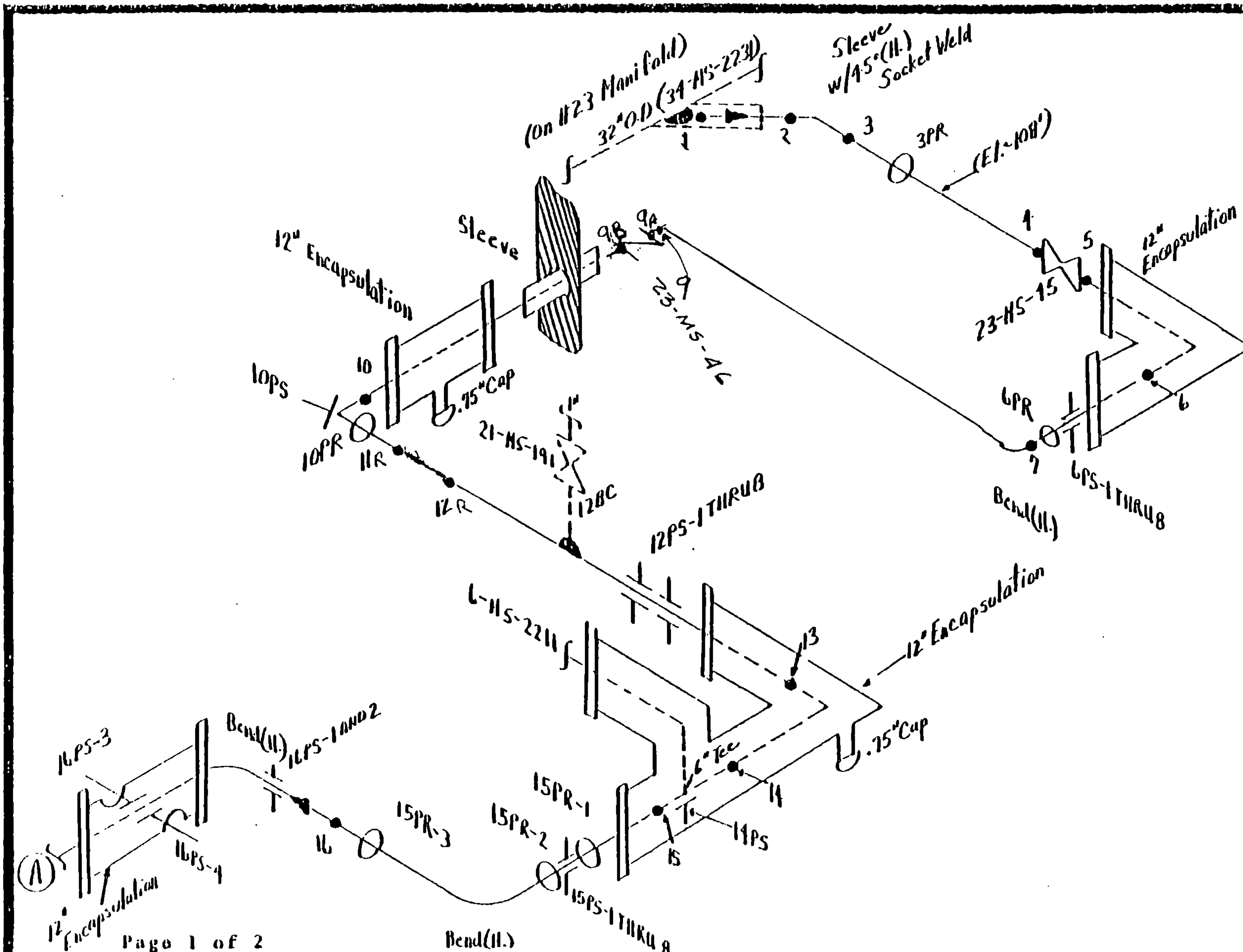
*PSE&G No:	8"-2MS1114	8"-2MS1115	8"-2MS1116	8"-2MS1117	8"-2MS1118	6"-2MS1487
*SwRI No:	8-MS-2231	8-MS-2232	8-MS-2233	8-MS-2234	8-MS-2235	6-MS-2236

PSE&G No: See Above*	PSE&G Dwg: MS-2-3 Sht. 4	Thickness: See Above:*
SwRI No: See Above*	Basic Cal. Blk.: See Above*	Figure: B-39



8-MS-2231 TO 6-MS-2236

FIG. B-39A



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PSE&G No: 6"-2MS1056,1058	PSE&G Dwg: MS-2-2 Sht. 1	Thickness: 0.432"
SwRI No: 6-MS-2231	Basic Cal. Blk.: 6-CS-80-.432-49-SAM	Figure: B-43

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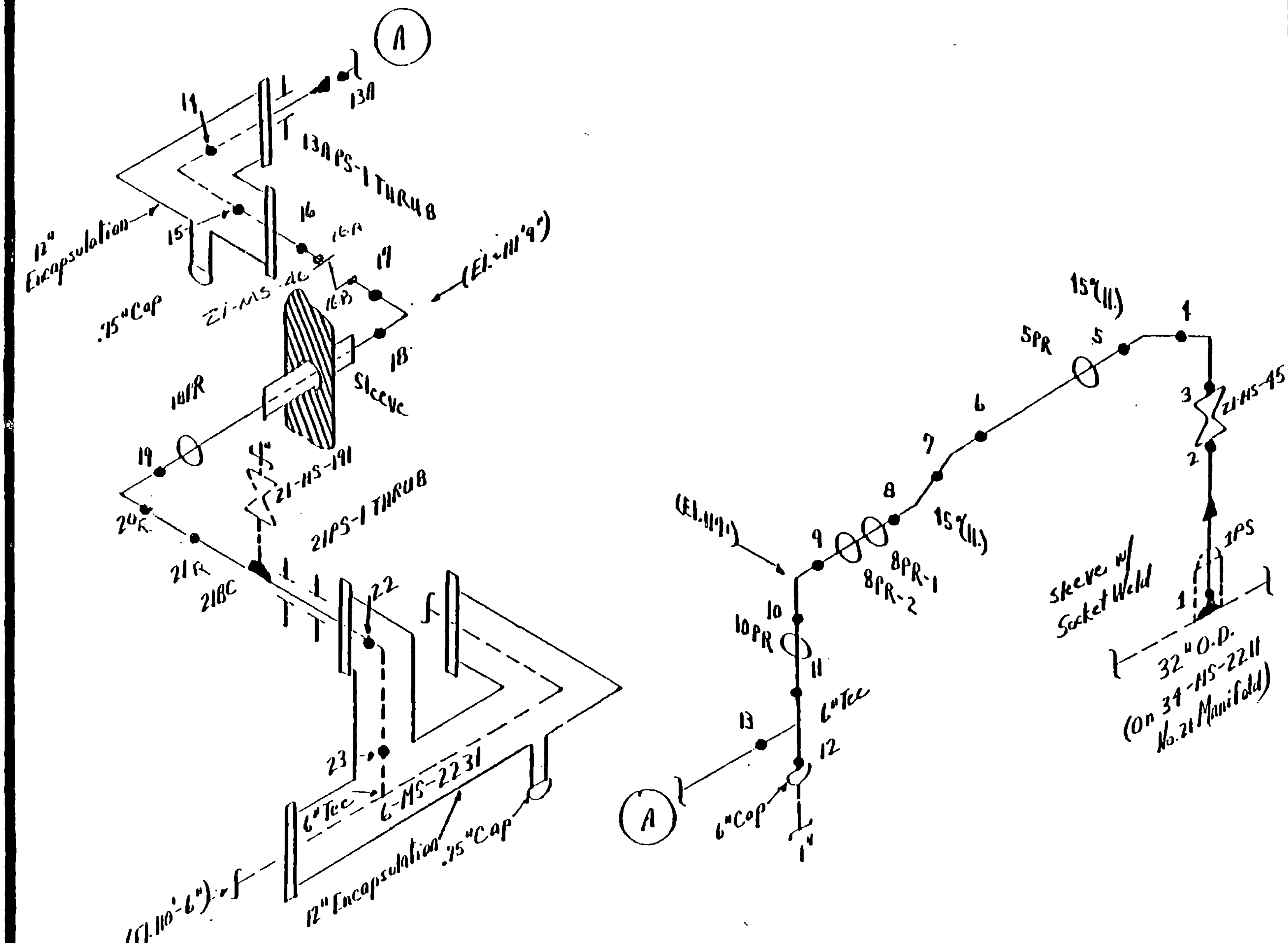
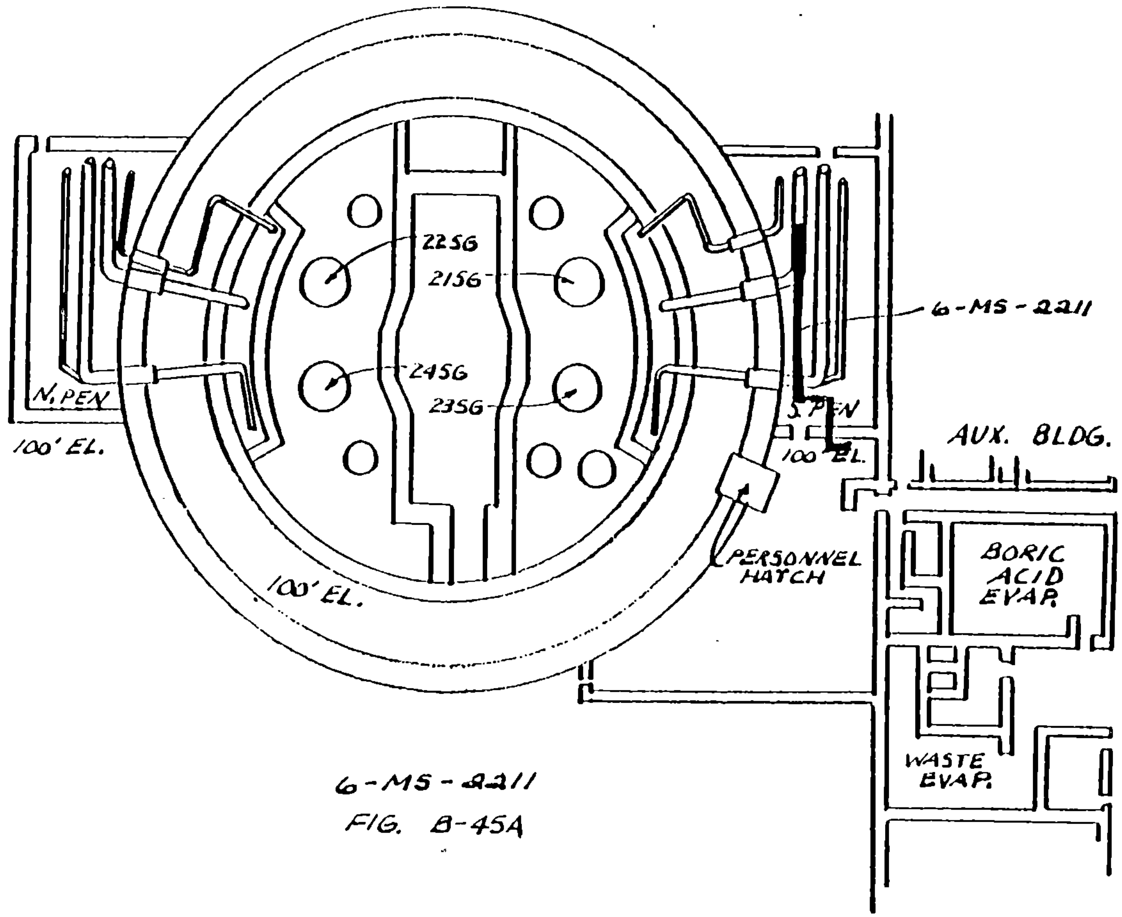
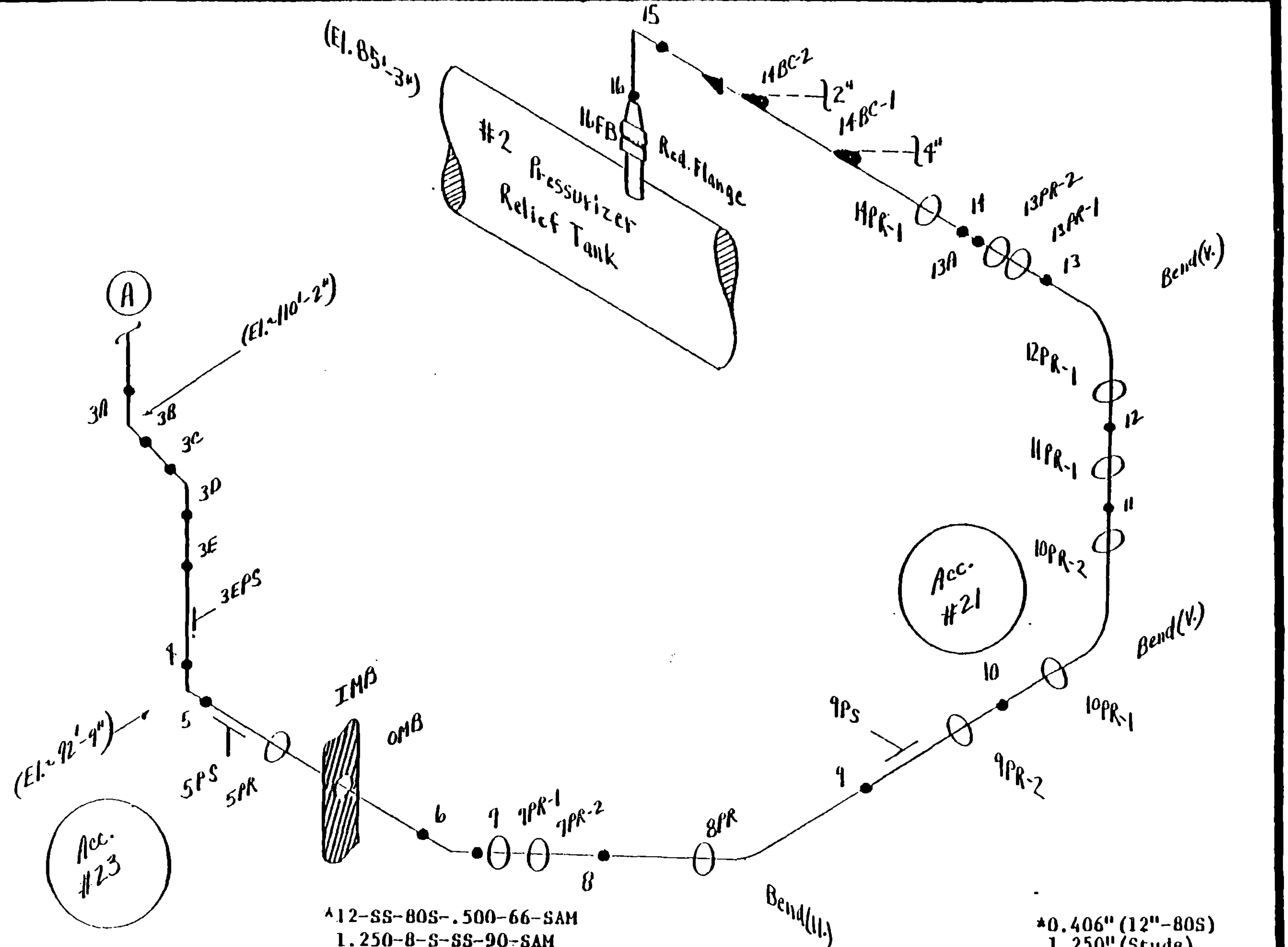


PSE&G No: 6"-2MS1056	PSE&G Dwg: MS-2-2 Sht. 1	Thickness: 0.432"
SwRI No: 6-MS-2211	Basic Cal. Blk.: 6-CS-80-.432-49-SAM	Figure: B-45



6-MS-2211
FIG. B-45A

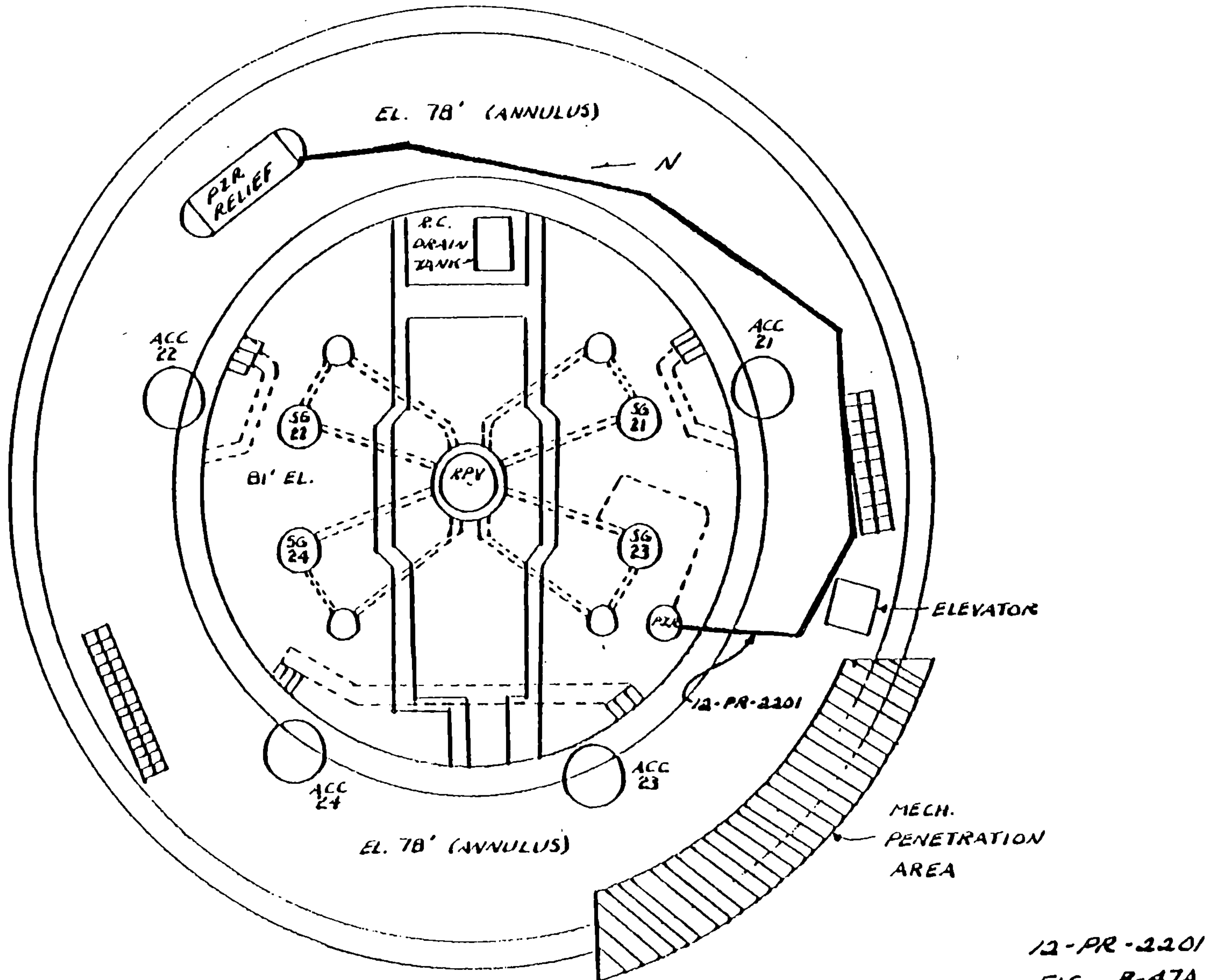


*12-SS-80S-.500-66-SAM
1.250-8-S-SS-90-SAM
1.250-8-N-SS-93-SAM

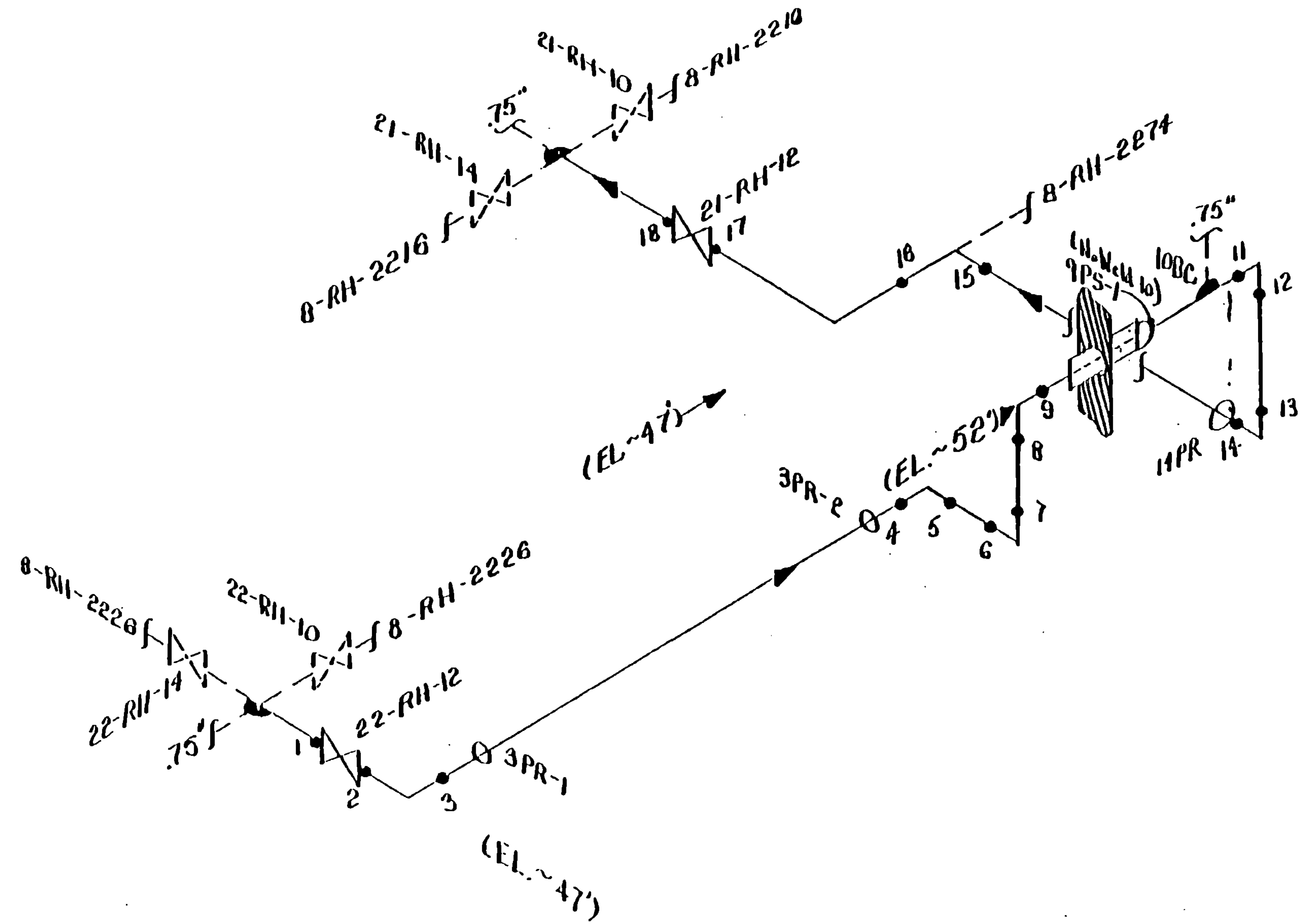
*0.406" (12"-80S)
1.250" (Studs)
1.250" (Nuts)

Page 2 of 2

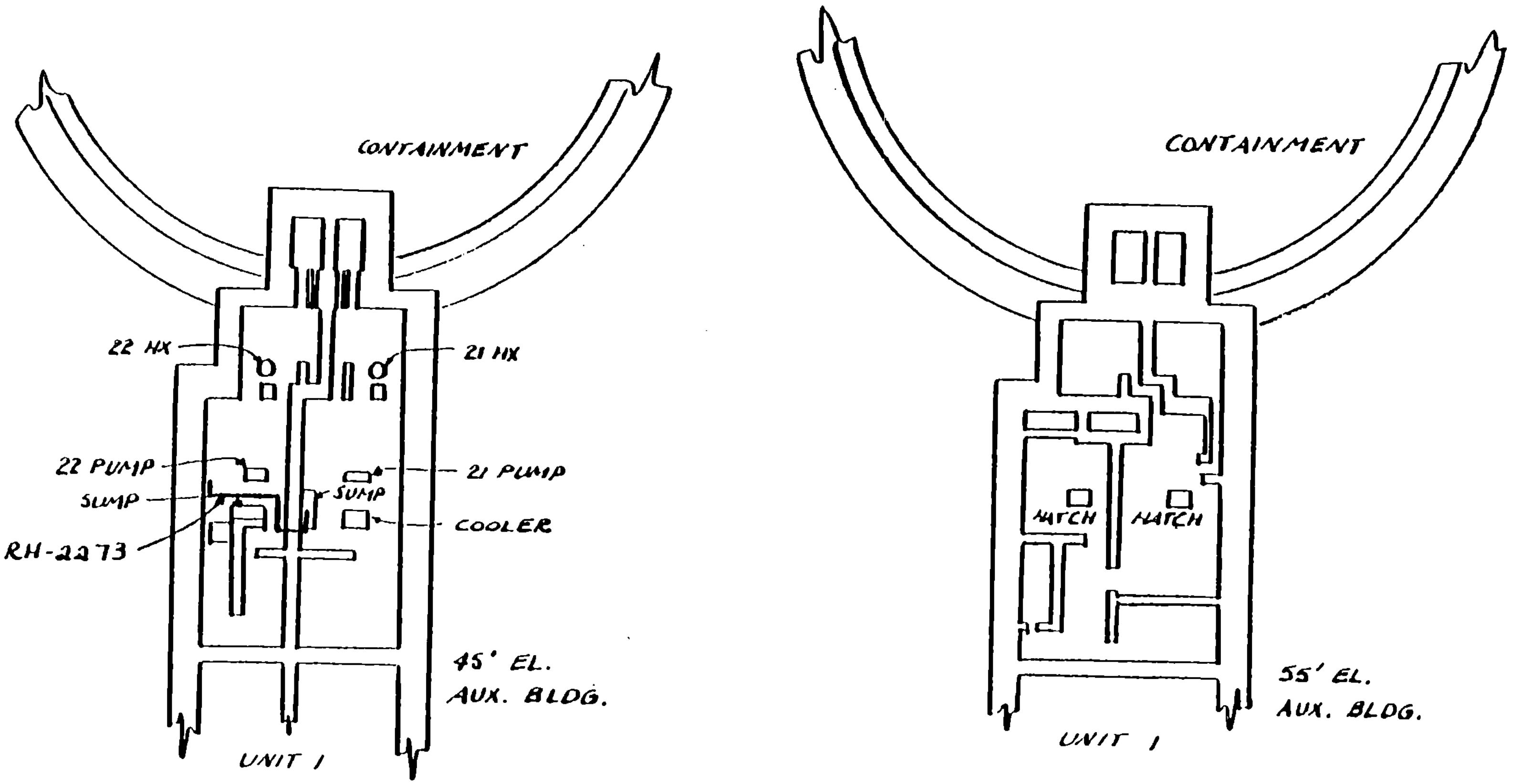
PSE&G No: 12"-2PR1010	PSE&G Dwg: RC-2-3 Sht. 3	Thickness: See Above*
SwRI No: 12-PR-2201	Basic Cal. Blk.: See Above*	Figure: B-47



12-PR-2201
FIG. B-47A



PSE&G No: 8"-2RH1016	PSE&G Dwg: RH-2-2 Sht. 1,2	Thickness: 0.322"
SwRI No: 8-RH-2273	Basic Cal. Blk.: 8-SS-40-.330-44-SAM	Figure: B-59



8-RH-2273
FIG. B-59A

APPENDIX C

SwRI NUCLEAR PROJECTS OPERATING PROCEDURES

APPENDIX C

SwRI NUCLEAR PROJECTS OPERATING PROCEDURES

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APPENDIX C

SwRI NUCLEAR PROJECTS OPERATING PROCEDURES

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*For erosion/corrosion examinations, reported separately.
**For one examination in Salem, Unit 1

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Title

RECORDING DATA FROM DIRECT VISUAL, LIQUID PENETRANT AND MAGNETIC PARTICLE EXAMINATIONS

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-5	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Russell Fine Date: 8 Feb 90

Technical Review: Joel A. Gochin Date: 8 FEB 90

Approved By: David Frank Rosow Date: 2/9/90
Department Director

SwRI Form QA-3A-0

RECORDING DATA FROM DIRECT VISUAL, LIQUID PENETRANT AND MAGNETIC PARTICLE EXAMINATIONS

SwRI-NDE2

1. PURPOSE AND APPLICATION

This procedure provides the technical information and detailed steps required for recording data from direct visual, liquid penetrant, and magnetic particle examinations of components, welds, heat-affected zones, and adjacent base material.

2. APPLICABLE DOCUMENTS

(1) Southwest Research Insitute (SwRI) Nuclear Quality Assurance Program Manual (NQAPM).

(2) The applicable nuclear projects operating procedure for the examination being conducted.

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PROCEDURE REQUIREMENTS

(1) Personnel utilizing this procedure shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

(2) Examination shall be conducted as required by the applicable NPOPs.

5. PROCEDURE

5.1 Definitions

L measurements	-	Measurements recorded at the centerline of the weld and parallel to the weld for nontransverse indications.
L_0 location	-	The origin for L measurements.
W measurements	-	Measurements recorded on either side of the weld, perpendicular to the weld for nontransverse indications.
W_0 location	-	The origin for W measurements.

5.2 Weld Length

Weld length, when required, shall be measured with a steel measuring tape and the distance recorded in inches and common fractions to the nearest 1/16 inch.

(1) For circumferential, longitudinal, and nozzle-to-shell welds, the weld length shall be measured along the weld centerline.

NOTE

The weld length shall be 12 inches when only 12 inches of the longitudinal weld is required to be examined. Enter the notation "12 inches" in the appropriate space provided on the examination record. For longitudinal welds less than 12 inches, enter the weld length examined.

(2) For branch connection welds, lugs, supports and other similarly welded attachments with fillet type weld surfaces, the weld length shall be measured on the component surface at the junction of the weld fusion line and the component surface, i.e., vessel or pipe surface.

5.3 L Measurements

L measurements shall be recorded in inches and common fractions, to the nearest 1/16 inch.

L measurements shall be made directly from L_0 to the geometric center of the indication.

L measurements for components with a flow direction, other than branch connection and nozzle-to-shell, shall be made clockwise looking in the direction of the flow. Branch connections and nozzle-to-shell measurements shall be made clockwise from L_0. Measurements for components without a flow direction shall be made clockwise as viewed from above the vertical component or clockwise as viewed from an identified end of a horizontal component. The end of the horizontal component referenced to determine clockwise shall be recorded in the REMARKS section of the applicable Examination Record.

L measurements shall be made clockwise as viewed from the top side of the stud, bolt, nut or washer; or as viewed from an identified end of the component. L measurements for other nonwelded components, e.g., cladding patches, shall be made from an L_0 described on the appropriate Examination Record.

(1) For circumferential, nozzle-to-shell, and longitudinal welds, the L measurements shall be made along the weld centerline.

(2) For branch connection, lugs, supports and other similar welded attachments with fillet-type weld surfaces, the L measurements shall be made along the weld fusion line on the component surface, i.e., pipe or vessel surface.

(3) For studs, bolts, nuts, washers, and other nonwelded components, the L measurements shall be made from L_0 to the geometric center of the indication.

5.4 W Measurements

W measurements shall be recorded in inches and common fractions, to the nearest 1/16 inch.

(1) For circumferential, nozzle-to-shell, and longitudinal welds, the W measurements shall be made perpendicular to the weld centerline from W_0 to the geometric center of the indication.

(2) For branch connections, supports, and other similarly welded attachments with fillet-type weld surfaces, the component surface used to determine W_0 shall be identified on the applicable Examination Record. W measurements shall be made perpendicular to the weld from W_0 to the geometric center of the indication.

(3) For studs, bolts, nuts, washers, and other nonwelded components, the W measurements shall be made from W_0 to the geometric center of the indication. W measurements for studs or bolts with heater holes, nuts, and washers shall be made from the top edge of the bore or heater hole and continue down the component. W measurements for studs or bolts without heater holes shall be made from the top center of the component. Measurements for other types of nonwelded components, e.g., cladding patches, shall be made from W_0 determined by the examiner and described on the appropriate Examination Record.

5.5 Indication Types

Indications shall be recorded on the applicable Examination Record as rounded, linear, or as a group of rounded indications. Further information about the indication shall be recorded under the REMARKS section of the applicable Examination Record.

(1) Rounded Indications

A rounded indication shall be an indication which is less than three times as long as it is wide.

(2) Linear Indications

A linear indication shall be an indication which is equal to or greater than three times as long as it is wide.

(3) Group of Rounded Indications

The size of the area and the number of rounded indications required to be recorded, when applicable, shall be a stipulated in the applicable nuclear projects operating procedure.

5.6 **Indication Size**

The size of an indication shall be measured to the nearest 1/32 inch with a 6-inch steel scale or steel measuring tape.

(1) Rounded Indications

Round indications or indications closer to being round than elliptical shall be measured at the maximum diameter. Elliptical indications shall be measured across the maximum length and maximum width.

(2) Linear Indications

Linear indications shall be measured along the length of the indication.

5.7 **Abbreviations**

Appropriate abbreviations (listed below), which describe the indication location with respect to W_0, shall be entered on the applicable Examination Record with the measurements.

(1) Up/Upstream - Up

(2) Down/Downstream - Dn

(3) Clockwise - CW

(4) Counterclockwise - CCW

(5) Centerline - ℄

(6) Vessel side - V

(7) Lug or support side - L or S

(8) Pipe Side - P

6. **RECORDS**

Records shall be maintained in accordance with the applicable nondestructive examination procedure.

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SwRI-NDE3 Rev. 0, Chg. 0 March 1990 Page 1 of 14

Title

RECORDING INDICATIONS DURING ULTRASONIC EXAMINATIONS

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-14	0	3/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Lyle Spiess for RHF Date: 3/21/90

Technical Review: Hector Diaz Date: 3/21/90

Approved By: David Frank Rosow Date: 3/21/90

Department Director

SwRI Form QA-3A-0

RECORDING INDICATIONS DURING ULTRASONIC EXAMINATIONS

SwRI-NDE3

1. PURPOSE AND APPLICATION

This procedure specifies the method for recording indications observed during ultrasonic examinations. Included are weld length measurements, search unit locations using reference points, indication metal paths and amplitudes, and examination limitations.

2. APPLICABLE DOCUMENTS

(1) Southwest Research Institute (SwRI) Nuclear Quality Assurance Program Manual

(2) The SwRI nuclear projects operating procedures (NPOP) for the ultrasonic examinations being conducted.

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL CERTIFICATION

Personnel utilizing this procedure shall be certified in accordance with SwRI NPOP 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

5. PROCEDURE

5.1 Weld Lengths

(1) Weld lengths, if required, shall be measured with a steel measuring tape and the distance shall be recorded in inches and common fractions to the nearest 1/16 inch. Weld length measurements shall start at zero reference points (L_0). See SwRI-NDE7 to determine the L_0 location.

(2) Weld lengths for circumferential, longitudinal and nozzle-to-shell welds shall be measured along the centerline of the weld.

(3) Weld lengths for branch connections and fillet-type welds shall be measured on the examination surface at the junction of the weld and the examination surface.

(4) The crown height and width for fillet welds shall be measured as shown in Figure 1.

5.2 Metal Path Measurements

Metal path measurements shall be recorded in inches and decimal fractions to the smallest screen division.

5.3 Amplitude Determination

Signal amplitude shall be measured as a percent of the calibrated distance amplitude correction (DAC). Determine the decibels (dB) above or below DAC by adjusting the gain control until the peak indication amplitude matches the DAC line. The percent of DAC shall be determined from Table 2.

5.4 Reference Points

5.4.1 Piping

Reference points with a maximum spacing of 5 inches shall be drawn on the weld centerline for circumferential, longitudinal, and fillet-type welds.

5.4.2 Vessels

CAUTION

Except for the requirements of Paragraph 5.4.2(3)(b), when the presence of high levels of radiation makes the layout of reference points impracticable, the following steps shall only be performed in areas where indications have been detected.

(1) Circumferential Butt Welds

(a) Reference points with a maximum spacing of 10 inches shall be drawn on the weld centerline, except vessel-to-flange welds examined from the seal surface. For vessel-to-flange welds examined from the seal surface, the reference points shall be the stud hole centerlines.

(b) Each reference point shall be laid out and identified on the vessel in inches from L_0 or from a determined, identifiable reference mark.

(2) Longitudinal Welds

(a) Reference points with a maximum spacing of 10 inches shall be drawn on the weld centerline. The reference points shall be laid out from the fusion line of the intersecting circumferential weld.

(b) Each reference point shall be identified on the vessel in inches from L_0 or from a determined, identifiable reference mark.

(3) Nozzle-to-Shell Welds

(a) A reference circle shall be drawn within 1/2 inch of the weld centerline. Points every 10 inches around the circle shall be marked on the vessel and should be utilized for the L measurements.

(i) L measurements shall be made along the circle from L_0 to the axial center of the search unit.

(ii) W measurements shall be made from weld centerline, which has been identified by the circle, to the exit point of the search unit.

(b) If the weld location cannot be determined, on the vessel surface, refer to nozzle drawing and calculate the circle defined above as follows:

(i) Measure the circumference of the nozzle boss and divide this distance by 6.28. This is the nozzle boss radius (NBR).

(ii) From the nozzle drawing, determine the weld centerline radius (CLR), and subtract the NBR from the CLR (CLR-NBR). This will be the distance from the nozzle boss to the reference circle.

5.5 L and W Measurements for Indications

(1) L and W measurements shall be recorded in inches and common fractions to the nearest 1/16 inch using a steel ruler or a steel measuring tape.

(2) Angle-beam L measurements will be made to the axial center of the search unit and W measurements will be made to the search unit exit point.

(3) Straight-beam DAC, L and W measurements shall be made to the axial center of the search unit.

(4) L and W measurements for straight-beam and angle-beam indications shall be made at each location as required in Table 1.

5.5.1 Piping

(1) Circumferential and Longitudinal Welds

(a) Indications Parallel to the Weld

L measurements shall be made from L_0 to the axial center of the search unit wedge.

W measurements shall be made from the center line of the weld to the exit point of the sound beam as marked on the search unit wedge.

(b) Indications Perpendicular to the Weld

L measurements shall be made from the center line of the weld to the axial center of the search unit.

W measurements shall be made from L_0 to the exit point of the sound beam as marked on the search unit wedge.

(c) L and W measurements for tangential scanning shall be made as shown in Figure 2.

(2) Branch Connections and Fillet-Type Welds

(a) Indications Parallel to the Weld

L measurements shall be made from L_0 to the axial center of the search unit wedge.

W measurements shall be made from the weld fusion line main run side to the exit point of the sound beam as marked on the search unit wedge.

(b) Indications Perpendicular to the Weld

L measurements shall be made from the weld fusion line main run side to the axial center of the search unit wedge.

W measurements shall be made from L_0 to the exit point of the sound beam as marked on the search unit wedge.

(c) L and W measurements for tangential scanning shall be made as shown in Figure 2.

5.5.2 Bolting

(1) Threads in Flanges

(a) L measurements shall be made from L_0 (vessel 0) to the center of the search unit.

(b) W measurements shall be made from the edge of the seal surface to the center of the search unit.

(2) Studs

(a) L measurements shall be made clockwise (CW) from L_0 [the stamped identification (ID) number]. .

(b) W measurements shall be made as follows:

(i) Studs with heater holes shall be measured from the edge of the hole to the exit point of the search unit.

(ii) Studs without heater holes shall be measured from the center of an identified end to the center of the search unit.

(3) Nuts

(a) L measurements shall be made as follows:

(i) The measurement for straight beam shall be made CW from L_0 (the stamped ID number) as viewed from the ID end of the component.

(ii) The measurement for angle beam shall be made from the outer edge of the ID end to the axial centerline of the search unit.

(b) W measurements shall be made as follows:

(i) The measurement for straight beam shall be made from the inside edge of the nut to the axial centerline of the search unit.

(ii) The measurement for angle beam shall be made CW from L_0 to the exit point of the search unit, as viewed from the ID end of the component.

5.5.3 Vessels

NOTE

When used as a reference point, Vessel 0-degree (Vessel 0) will be defined on the applicable SwRI Examination Record.

(1) Circumferential, Longitudinal, and Nozzle Welds

(a) Indications Parallel to the Weld

L measurements shall be made from L_0 (Vessel 0) to the axial center of the search unit wedge.

W measurements shall be made from the center line of the weld (℄ of weld) to the exit point of the sound beam as marked on the search unit wedge.

(b) Indications Perpendicular to the Weld

L measurements shall be made from the center line of the weld (℄ of weld) to the axial center of the search unit.

W measurements shall be made from L_0 (Vessel 0) to the exit point of the sound beam as marked on the search unit wedge.

(2) **Vessel-to-Flange Welds from the Seal Surface**

L measurements shall be made from L_0 (Vessel 0) to the center of the search unit.

W measurements shall be made from the edge of the flange seal surface and the inside surface of the vessel to the center of the search unit.

(3) **Nozzle Inside Radius**

For the method of recording indications observed during nozzle inside radius examinations, refer to the applicable examination procedure.

6. EXAMINATION LIMITATIONS

(1) When limitations to the scanning coverage requirements are encountered, W measurements shall be made to the search unit exit point for angle-beam or axial center for straight-beam search units. L measurements shall be made to the axial center of the search unit.

(2) When a weld cannot be examined from one side due to configuration, the limitations should be recorded as "no examination on the (UP, DN, CW, CCW, etc.) side due to configuration."

(3) When a partial examination is performed from one side or the other of a weld, the limitations for the lamination examination record should refer to the angle-beam examination record. The reference to the angle-beam examination may be recorded as "same as angle beam" or "see angle-beam limitations."

6.1 Straight Beam

Except as described above, limitations encountered during the straight-beam DAC and lamination examinations shall be recorded.

6.2 Angle Beam

Limitations shall be recorded for angle-beam examinations. For examinations which utilize two angles, the limitations of the search unit with the larger limitations shall be recorded.

7. SEARCH UNIT LOCATIONS

Appropriate abbreviations which describe the search unit location with respect to the weld centerline or edge (listed below) shall be entered on the applicable SwRI Examination Record with the measurements.

(1) Up/Upstream - UP

(2) Down/Downstream - DN

(3) Clockwise - CW

(4) Counterclockwise - CCW

(5) Weld Centerline - ℄

(6) Vessel side of centerline - V

(7) Lug or support side - L or S

(8) Head or shell side - H or S

(9) Other symbols with descriptions entered in the Remarks section may be used as approved by the Team Supervisor.

8. RECORDS

Required records shall be maintained in accordance with the applicable NPOP.

Table 1

REQUIRED L AND W RECORDING FOR INDICATIONS

PIPING

1974 Code Recording Requirements

Required L Positions	50% W_1	W_{max}	50% W_2
L_1 50%			
L_{max}		X	
L_2 50%			

1977 Through 1986 Code Recording Requirements

Required L Positions	100% W_1	W_{max}	100% W_2
L_1 50%			
L_1 100%			
L_{max}	X	X	X
L_2 100%			
L_2 50%			

X = Required recording position to include metal paths

Table 1 (Cont'd)

REACTOR PRESSURE VESSEL (RPV)

All nongeometric indications within the inner 25% of throughwall thickness shall be recorded as follows:

	20% W_1	50% W_1	100% W_1	>100 DAC 1/2 Max W_1	W_{max}	>100 DAC 1/2 Max W_2	100% W_2	50% W_2	20% W_2
L_1 20%	X				X				X
L_1 50%	X	X			X			X	X
L_1 100%	X	X	X		X		X	X	X
L Max	X	X	X	X	X	X	X	X	X
L_2 100%	X	X	X		X		X	X	X
L_2 50%	X	X			X			X	X
L_2 20%	X				X				X
L_{pos}	X	X	X	X	X	X	X	X	X

L_{pos} = Intermediate positions as required every 1/4 inch

All indications detected within the outer 75% of the throughwall thickness of the vessel wall, as measured from the inside surface, and geometric indications within the inner 25% of throughwall thickness shall be recorded as follows:

(1) Indications 50% to 100% DAC

	50% W_1	W_{max}	50% W_2
L_1 50%		X	
L_{max}	X	X	X
L_2 50%		X	
L_{pos}	X	X	X

(2) Indications Greater Than 100% DAC

	W_1 1/2 max	W_{max}	W_2 1/2 max
L_1 50%		X	
L_{max}	X	X	X
L_2 50%		X	
L_{pos}	X	X	X

X = Required recording positions to include metal paths
L_{pos} = Intermediate L positions as required every 9/10 of the transducer dimension

Table 1 (Cont'd)

OTHER THAN RPV

(1) Indications 50% to 100% DAC

	50% W_1	W_{max}	50% W_2
L_1 50%		X	
L_{max}	X	X	X
L_2 50%		X	
L_{pos}	X	X	X

(2) Indications Greater Than 100% DAC

	W_1 1/2 max	W_{max}	W_2 1/2 max
L_1 50%		X	
L_{max}	X	X	X
L_2 50%		X	
L_{pos}	X	X	X

X = Required recording positions to include metal paths

L_{pos} = Intermediate L positions as required every 9/10 of the transducer dimension

NOTE

Ultrasonic planar surface reflectors obtained at 100% or greater of the response from the square notch shall be recorded to the L and W limits of 100% of the notch amplitude.

Table 2

DAC VS. dB CONVERSION CHART

%DAC	dB	%DAC
100	0	100
90	1	112
80	2	125
70	3	141
63	4	159
56	5	178
50	6	200
45	7	224
40	8	251
36	9	282
32	10	316
28	11	355
25	12	400
22	13	447
20	14	501
18	15	562
16	16	631
14	17	708
13	18	794
11	19	891
10	20	1000

Percent DAC of an amplitude below DAC, which must be increased in amplitude by the dB number change to equal DAC, is read in the column on the left.

For example, an indication is increased in amplitude by 13 dB to equal the DAC curve; therefore, the indication is 22 percent of DAC.

Percent DAC of an amplitude above DAC, which must be decreased in amplitude by the dB number change to equal DAC, is read in the column on the right.

For example, an indication is decreased in amplitude by 13 dB to equal the DAC curve; therefore, the indication is 447 percent of DAC.

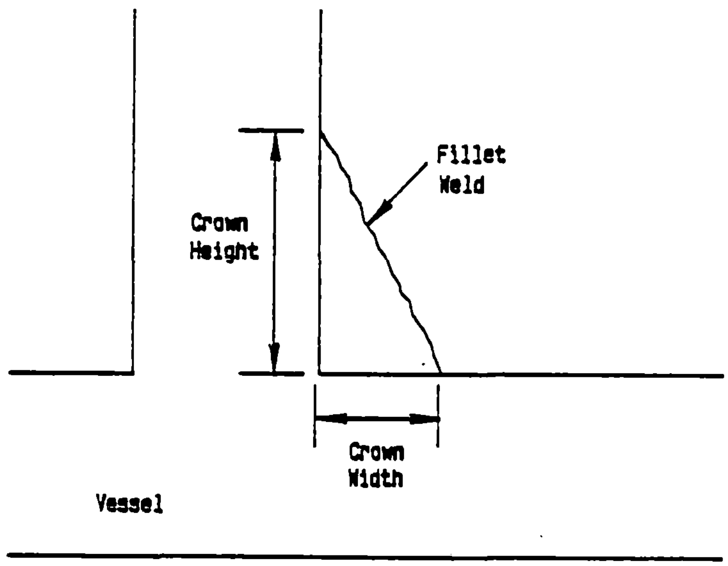
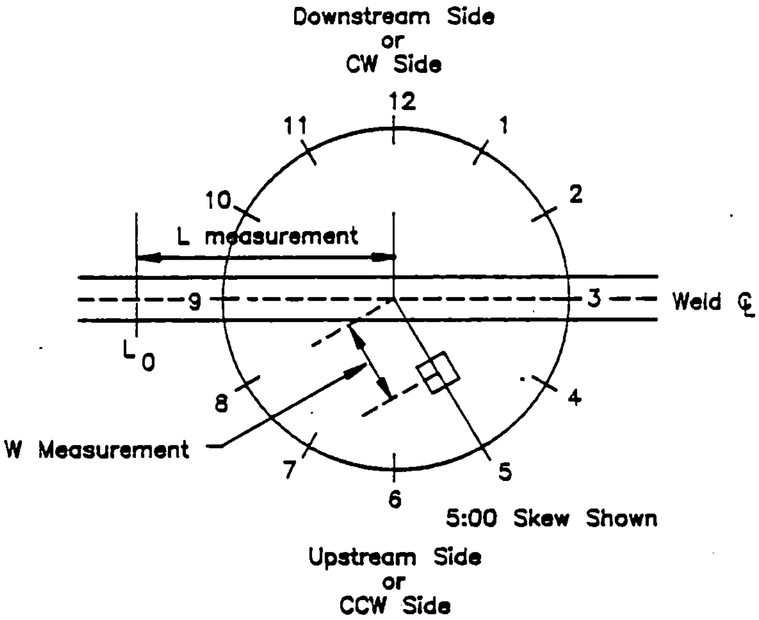


Figure 1. Fillet weld measurements

Circumferential and Longitudinal Welds



Branch Connection Welds

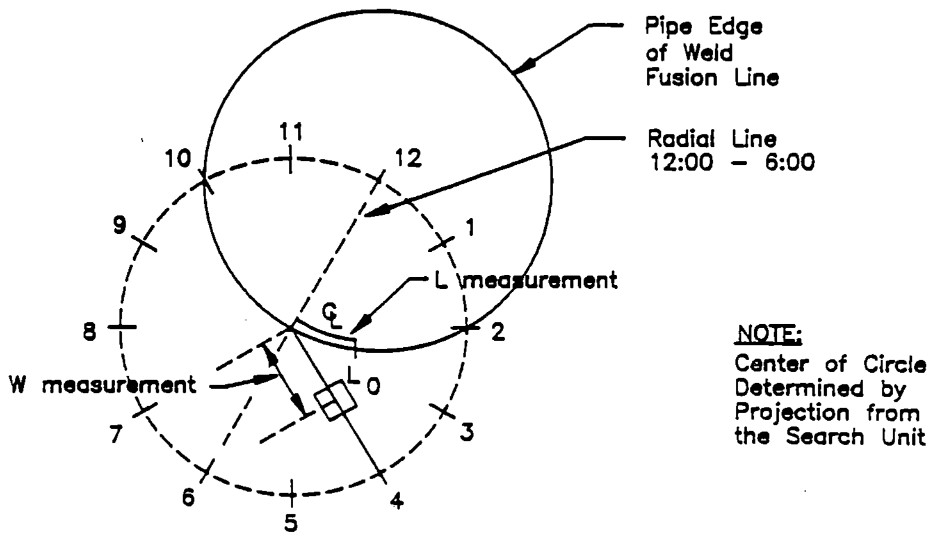


Figure 2. Measurements for tangential scanning on piping welds

SOUTHWEST RESEARCH INSTITUTE
NUCLEAR PROJECTS
OPERATING PROCEDURE

Title

ONSITE NDE RECORDS CONTROL

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-4	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Alfred R. Anderson Date: February 2, 1990

Technical Review: Steven A. Richter for GLP Date: February 2, 1990

Approved By: David Frank Rosow Date: 2/5/90
Department Director

ONSITE NDE RECORDS CONTROL

SwRI-NDE4

1. PURPOSE AND APPLICATION

This procedure describes the onsite control required for nondestructive examination (NDE) records generated at a nuclear power facility. These records include original examination, summary, and resolution records, magnetic tapes, videotapes, and other information as defined by the Project Manager.

2. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

(3) The Inspection Engineer shall be responsible for the implementation of this procedure.

3. PROCEDURE

3.1 Original Examination Records

(1) Original examination records are to be serialized either at Southwest Research Institute (SwRI) or at the site.

(2) Original examination records shall be filled out at the examination location and during the examination time.

(3) The examination records shall be turned in to the team staging area (office, trailer, etc.) on a periodic basis (e.g., at meal time, at the end of the day, upon leaving controlled areas) for final review.

(4) The review process is performed as follows:

   (a) The original examination records shall be checked for completeness and accuracy.

   (b) If the original examination record requires clarification or correction, it shall be returned to the examiner.

   (c) After clarifications or corrections, if any, have been made and initialed by the examiner, the reviewer shall sign each record which does not contain indications requiring evaluation/resolution.

(5) The original examination records which have been reviewed and signed shall be summarized in accordance with Subsection 3.3.

(6) Original examination records which contain indications requiring evaluation/ resolution shall be resolved as follows:

(a) Original examination records requiring evaluation/resolution which document visual or surface examinations shall be reviewed, signed by the reviewer, and used to generate a Customer Notification Form (CNF). The CNF shall be completed in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) SwRI-NDE6. These documents shall then be filed in accordance with Subsection 3.3.

(b) Original examination records requiring evaluation/resolution which document ultrasonic examinations shall be used to resolve the indications according to Subsection 3.2.

3.2 <u>Resolution Records</u>

(1) Resolution records are to be serialized either at SwRI or at the site.

(2) The Level II or Level III examiner shall take the steps necessary to resolve the ultrasonic indications and complete a resolution record describing the results of his analysis. Any additional documentation required to support the resolution shall be attached.

(3) Original examination records and resolution records with indications requiring no further action shall be reviewed and summarized in accordance with Subsection 3.3.

(4) Examination records with indications requiring further action shall be reported to the Director of the Department of NDE Services.

(5) Indications which have been deemed reportable and require Customer disposition shall be reported on a CNF form. The CNF shall be completed in accordance with SwRI NPOP SwRI-NDE6.

3.3 <u>Summary Records</u>

(1) Summary Records are to be serialized either at SwRI or at the site.

(2) Summary Records shall be completed for each examination area prior to the conclusion of site activities. In certain cases (studs, nuts, etc.), one summary record may be used for more than one examination area.

(3) When a computer is used to generate summary records, examination results shall be entered into the computer. The computer will generate the summary records when all required information has been entered.

(4) If the computer is not used to generate summary records, they will be completed manually.

(5) Summary Records shall be filed with the original examination records.

3.4 Magnetic Tapes, Videotapes, and Laser Disks

(1) Magnetic tapes, videotapes, and laser disks generated during automated ultrasonic examinations shall be identified with a sequence number and with the examination areas for which they contain data.

(2) During the resolution of any indications, the videotapes and/or laser disks may be used by the Level II or Level III examiner, as needed.

4. Customer Review

The Customer may elect to review and approve original examination records prior to shipment to SwRI. SwRI personnel will assure that the examination records are complete and reviewed by a Level II prior to Customer review.

5. RECORDS

Prior to departing the site, the original examination record package with the exception of magnetic tapes, videotapes, and laser disks shall be reproduced and a copy shall be transmitted to the Customer.

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SwRI-NDE6 Rev. 0, Chg. 0 January 1990 Page 1 of 4

Title

USE OF CUSTOMER NOTIFICATION FORMS

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-4	0	1/90

Supersedes Previous Revision/Changes? X Yes ☐ No

Prepared By: Alfred R Anderson Date: January 31, 1990

Technical Review: Steven A. Richter Date: January 31, 1990

Approved By: David Frank Rosow Date: 1/31/90
Department Director

SwRI Form QA-3A-0

USE OF CUSTOMER NOTIFICATION FORMS

SwRI-NDE6

1. PURPOSE AND APPLICATION

This procedure describes the steps to be followed when a Customer Notification Form (CNF) is issued. A CNF will be issued to notify a Customer of (1) reportable nondestructive examination results, and (2) other relevant information.

2. APPLICABLE DOCUMENT

Southwest Research Institute (SwRI) Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the implementation of this procedure.

4. PROCEDURE

(1) When required, a CNF (see Figure 1 for example) shall be issued. A CNF should be issued as soon as possible, but certainly prior to the completion of site activities.

(2) When a CNF(s) is issued, a log shall be maintained in order to track progress until the CNF is closed.

(3) The five parts of a CNF are normally completed as follows:

(a) The SwRI representative initiates the CNF by describing the relevant information in Part I, noting and attaching any applicable examination records. When the CNF is submitted, the Customer will sign in Part II to acknowledge receipt, and SwRI will retain one copy.

(b) The Customer indicates the desired disposition and, if required, a reexamination is performed. These notifications may be handled verbally until the reexamination reveals the desired results. At that time, both Parts III and IV shall be completed.

(c) Finally, in order to assure Customer satisfaction with the final disposition, the Customer will sign Part V.

(d) SwRI will retain a fully completed copy (the original is preferable to assure good quality copies in the final report).

(4) The procedure in (3) above may be modified at Customer request and Project Manager concurrence, provided the intent is maintained.

5. RECORDS

CNF(s) produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by the Customer.

SOUTHWEST RESEARCH INSTITUTE

CUSTOMER NOTIFICATION FORM

Project No. ______ Site: ______ CNF Serial No. ______

Examination Area: ______ Procedure No. ______

PART I - SwRI Finding

Comments: ______

Attachments: ______

SwRI Signature: ______ Date: ______

PART II - CNF Received By

Customer Signature: ______ Date: ______

PART III - Disposition by Customer

Comments: ______

Customer Signature: ______ Date: ______

PART IV - Reexamination

Comments: ______

Attachments: ______

SwRI Signature: ______ Date: ______

PART V - CNF Closed By

Customer Signature: ______ Date: ______

SwRI Form NDTR-CNF-1, Rev. 2

Figure 1. Example of a CNF

	SOUTHWEST RESEARCH INSTITUTE **NUCLEAR PROJECTS** **OPERATING PROCEDURE**	SwRI-NDE7 Rev. 0, Chg. 0 February 1990 Page 1 of 5

Title

WELD JOINT IDENTIFICATION MARKING

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-5	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Alfred R. Anderson Date: 26 Feb 1990

Technical Review: Grady C. Eagleden Date: 26 Feb 90

Approved By: David Frank Rosow Date: 3/5/90
Department Director

SwRI Form QA-3A-0

WELD JOINT IDENTIFICATION MARKING

SwRI-NDE7

1. PURPOSE AND APPLICATION

This procedure describes a method of locating and marking zero reference points (L_0) and weld identification numbers adjacent to nuclear power plant piping welds and attachments.

2. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

3. PROCEDURE

3.1 General

In addition to the requirements of this procedure, the policies, practices, and rules of the nuclear plant shall be followed in the execution of the marking operation. Marking equipment shall be approved by the customer prior to use.

3.2 Equipment

(1) For initial marking, or when only temporary marking is desired, a marking pencil or commercial pipe marker may be used.

(2) For permanent marking, a commercial electric engraver, pneumatic engraver, or low-stress punch may be used. If an engraver is used, the tip shall be manufactured of commercial-grade diamond or tungsten carbide material.

3.3 Determination of Zero Reference Location on Welds

The following rules shall be observed in determining the zero reference location (L_0) on circumferential, longitudinal and branch connection piping welds, and welded piping lugs and piping supports. If more than one rule is applicable, the lowest numbered rule shall be applied.

(1) Rule 1. For any pipe having a horizontal component at the weld (any pipe positioned at other than 90° from the horizontal), use the top centerline of the weld.

(2) Rule 2. If a pipe is vertical at the weld (no horizontal component) and the weld is either an elbow-to-Z or a Z-to-elbow, where Z is any piping component other than an elbow, use the centerline of the outside radius of the elbow.

(3) Rule 3. If a pipe is vertical at the weld (no horizontal component) and the weld is a pipe-to-pipe, elbow-to-elbow, Z-to-pipe, or pipe-to-Z, where Z is any piping component other than an elbow, use an extension of the centerline of the outside radius of the elbow above the weld.

(4) Rule 4. If in rule (3) there is no elbow above the weld, use an extension of the centerline of the outside radius of the elbow below the weld.

(5) Rule 5. If Rule (3) or (4) cannot be used because no elbows are visible, choose the most convenient location. When referring to Rule (5), describe the method for establishing L_0 on the Examination Record.

(6) Rule 6. For branch connection welds (saddle welds, sweepolets, weldolet, etc.) and for welded lugs and pipe supports, use the upstream intersection of the weld and the centerline of the branch connection, lug, or support, as applicable.

(7) Rule 7. For a longitudinal weld intersecting a circumferential weld, use the junction (near or inside edge of the circumferential weld) of the longitudinal with the circumferential.

NOTES

A pipe-to-tee weld is considered to be a circumferential weld in the branch pipe and Rules (1) through (5) apply.

It may not always be possible to determine L_0 locations by the prescribed rules. In such cases, the (L_0) may be determined with the location which most closely matches the desired location as established in the rules. The examiner shall subsequently describe the actual location on the applicable Examination Record.

3.4 Weld Joint Identification

The area to be marked shall be free of weld spatter, rust, rough surfaces, or any other condition which would prevent clear marking.

The L_0 reference for each weld shall be located in accordance with Subsection 3.3 of this procedure (also see Figure 1). The L_0 reference mark (-0-) shall be placed at that location.

Each weld joint should be marked with its appropriate identification number traceable to the Examination Plan and/or weld identification figures.

If weld joint inaccessibility prevents use of the equipment or methods described in this procedure, other zero reference or weld joint identification number locations may be used as considered necessary and acceptable by the Project Manager, Inspection Engineer, or Team Supervisor. Under these circumstances, a description of the equipment or methods used shall be entered on the applicable Examination Record.

4. RECORDS

Records generated in accordance with this procedure shall be stored and maintained in accordance with project requirements.

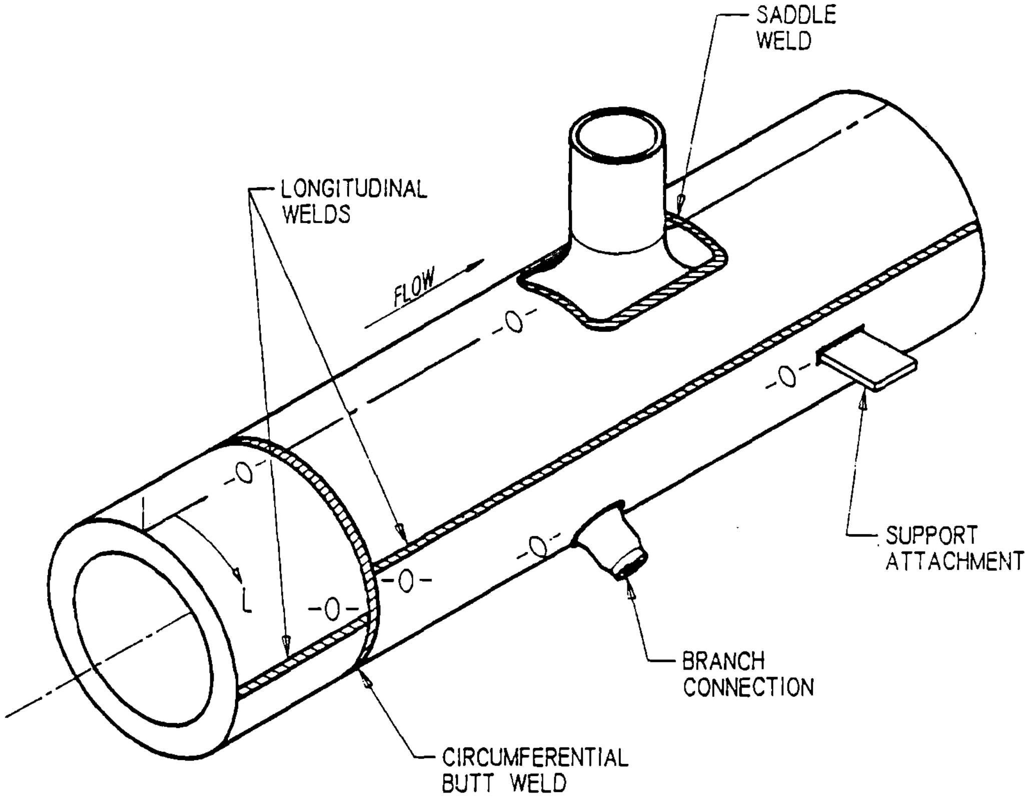


Figure 1. Zero Reference Location on Welds

INTERIM CHANGE NOTICE

ICN No. 1

Page 1 of 1

Procedure No.: SAM2-PT1 Rev. No.: 0 Change No.: 0

Change The Following Paragraphs/Sentences To Read:

Add or Delete The Following Paragraphs/Sentences:

Add 7.1(5) For flywheel examinations, all indications 1/16-inch or greater shall be recorded.

ICN For Specific Application? ☒ Yes ☐ No If Yes, So State:

Flywheel examinations performed in accordance with Reg. Guide 1.14, Revision 1 dated August 1975

ICN For Specific Period? ☐ Yes ☒ No If Yes, ICN Expires

Verbal Approval Given? ☐ Yes ☒ No NPOP Rev./Chg. Req'd. ☐ Yes ☒ No

Prepared By: John [illegible] Date: 11 Jun 90

Technical Review: Russell [illegible] Date: 11 June 90

Approved By: [illegible] for DFR Date: 11 June 90
Department Director

SwRI Form QA-121-1

SwRI	**SOUTHWEST RESEARCH INSTITUTE** **NUCLEAR PROJECTS** **OPERATING PROCEDURE**	SAM2-PT1 Rev. 0, Chg. 0 February 1990 Page 1 of 8

Title

SOLVENT-REMOVABLE LIQUID PENETRANT COLOR CONTRAST EXAMINATION

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-8	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: JK Inmanells Date: 2/14/90

Technical Review: Joel A. Godini Date: 21 FEB 90

Approved By: David Frank Rosow Date: 2/26/90
Department Director

SwRI Form QA-3A-0

SOLVENT-REMOVABLE LIQUID PENETRANT COLOR CONTRAST EXAMINATION

SAM2-PT1

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure proper liquid penetrant examination of nonporous aluminum, austenitic, or carbon steel materials in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) The color contrast method of solvent-removable liquid penetrant examination shall be employed as specified in this procedure for detection of surface discontinuities in aluminum, austenitic, or carbon steel material.

(3) Components and welds to be examined are specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of nde Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Material/Equipment Certification

(1) The penetrant materials used shall be certified for sulfur content and total halogens in accordance with ASTM D-129-64 and ASTM D-808-63.

(2) Certified reports for all surface contact materials to be used for penetrant examinations, giving batch numbers and analysis results, shall be obtained from the supplier. Copies of the certified reports shall be retained with the examination records.

(3) Equipment used to measure surface temperature shall have been calibrated and certified, and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

4.3 Materials and Equipment

The following materials and equipment shall be used for examinations performed in accordance with this procedure:

(1) Precleaner - Spotcheck, Type SKC-NF or Type SKC-S

(2) Penetrant - Spotcheck, Type SKL-HF/SKL-S or SKL-HF/S

(3) Penetrant Remover - Spotcheck, Type SKC-NF or Type SKC-S

(4) Developer - Spotcheck, Type SKD-NF or Type SKD-S

(5) A thermometer, certified as described in Section 4.2

(6) A flashlight or drop light

4.4 Safety Precautions

Safety precautions in accordance with instructions furnished with each manufacturer's penetrant material shall be observed. Highly volatile solvents shall be used cautiously since the vapors may be toxic and the liquids may irritate the skin. Extreme care should be exercised in handling highly flammable solvents.

5. EXAMINATION METHOD

5.1 Surface Condition

(1) Unless otherwise specified by Public Service Electric and Gas Company (PSE&G), all penetrant examinations shall be performed on components in their final surface condition.

(2) The surface to be examined and adjacent areas for a minimum of 1 inch shall be free from scale, slag, dirt, grease, weld spatter, oil, paint, or any other extraneous matter that would obscure surface openings or otherwise interfere with the examination.

CAUTION

Blasting with shot or dull sand may peen discontinuities on the surface and shall not be used.

NOTE

Where surface conditions are not in accordance with Subsection 5.1 and correction is not feasible, SwRI will conduct the examination only at the request of PSE&G. The specific surface condition and its probable effect on the examination shall be noted on the SwRI Liquid Penetrant Examination Record.

5.2 Preexamination Cleaning

(1) The surface to be examined and adjacent areas within at least 1 inch shall be thoroughly washed with precleaner in such a manner that foreign material and contaminants are removed.

(2) The examination surface shall then be wiped dry with a lint-free cloth or absorbent paper, allowing a minimum of 5 minutes for complete evaporation.

5.3 Temperature Readings

The serial number of the thermometer used and the examination surface temperature (after preexamination cleaning and before application of penetrant) shall be recorded on the SwRI Liquid Penetrant Examination Record.

5.4 Application of Penetrant

(1) The penetrant shall be taken from a clean, controlled container to ensure its purity. It shall be applied by brushing or spraying and shall evenly cover all areas of the surface being examined.

(2) The allowable minimum and maximum penetrant dwell times shall be as follows:

Component Temperature (°F)	Dwell Time (Minutes)
60-70	20-30
71-90	10-30
91-100	10-20
101-125	10-15

(3) When examinations are to be performed on components whose temperature is below 60°F or above 125°F, this procedure shall be qualified in accordance with the requirements of Section V, Article 6, Subarticle T-660.

(4) The penetrant shall not be allowed to dry. If drying occurs, the penetrant shall be removed and the entire procedural process shall be repeated.

5.5 Removal of Excess Penetrant

(1) Initially, the excess penetrant shall be removed by wiping the surface with clean, dry, lint-free cloths or absorbent paper until most traces of excess penetrant have been removed.

(2) A clean, dry, lint-free cloth or absorbent paper shall then be moistened with penetrant remover, and the surface shall be wiped lightly until all remaining traces of excess penetrant have been removed. Extreme care shall be employed to avoid the use of an excessive amount of remover in order to preclude the removal of penetrant from discontinuities.

(3) The surface shall not be flushed nor receive direct application of remover prior to the application of the developer.

5.6 Drying

(1) The surface shall be completely dry prior to the application of the developer.

(2) Drying time shall be a minimum of 5 minutes to a maximum of 30 minutes after the excess penetrant has been removed.

5.7 Application of Developer

(1) The wet developer shall be applied by spraying from a pressurized container.

(2) After sufficient agitation of the pressurized container to ensure that the particles in suspension are dispersed, a smooth, uniform layer of the suspended powder shall be sprayed onto the surface.

(3) The developer shall be used sparingly. The proper developer thickness will dry to a thin, translucent layer. If the coating is too thick, it may mask indications. The examination surface shall be observed during the application of the developer to monitor the behavior of indications which tend to bleed-out profusely.

(4) Final interpretation of indications shall be made a minimum of 7 minutes to a maximum of 30 minutes after the developer has been applied.

6. EXAMINATION

6.1 Examination Areas

(1) Components, parts, and methods of examination shall be as specified in ASME Boiler and Pressure Vessel Code, Section XI, Tables IWB-2600 and IWC-2600.

(2) The examination area for circumferential and longitudinal welds shall be the weld and adjacent base material for a distance of 1t to either side of the weld fusion line.

(3) The examination area for branch connections shall include the weld and base material for a distance of 1t from the weld fusion line on the main run pipe and at least 2 inches of the base material along the branch run.

(4) The examination area for support attachments shall include the weld and pipe or component base material for a distance of 1/2 inch from the weld fusion line, and the base material of the support attachment for a distance of two times the support thickness from the weld fusion line.

(5) 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.

(6) The examination for Class 1 socket welds in piping shall be the weld, 1t of base material on the pipe side, and 2.0 inches of base material on the fitting side.

6.2 Examination Methods

(1) Examinations shall be performed by placing the eye within 24 inches of the surface to be examined and at an angle no less than 30 degrees with the surface to be examined. A mirror may be used to improve the angle. In addition to general lighting, additional illumination of the examination area shall be provided at right and oblique angles to expose indications. The illumination shall be adequate to ensure no loss of sensitivity.

(2) If the examination surface is sufficiently large to preclude complete examination within the prescribed times, the surface shall be examined in suitable increments.

6.3 Postexamination Cleaning

(1) The developer and penetrant shall be removed by wiping the surface thoroughly with cloths saturated with a suitable solvent. Spraying directly on the examination areas with pressurized containers shall be allowed for postexamination cleaning.

(2) The surface shall then be wiped dry with clean, lint-free cloths or absorbent paper.

6.4 Reexamination

Indications that are believed to be nonrelevant shall be reexamined to verify whether actual defects are present. Surface conditioning may precede the reexamination. Nonrelevant indications and broad areas of pigmentation that would mask indications are unacceptable.

> **NOTE**
>
> Indications that are obviously nonrelevant such as stamp marks or radiograph punch marks, shall only be recorded as a general remark on the SwRI Liquid Penetrant Examination Record.

7. RECORDING AND REPORTING CRITERIA

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE2.

The following indications shall be recorded on the appropriate SwRI Liquid Penetrant Examination Record and reported to PSE&G.

7.1 Base Material Indications

(1) Linear Indications greater than 1/16-inch long for materials less than 5/8-inch thick, greater than 1/8-inch long for materials from 5/8-inch thick to under 2 inches thick, and 3/16-inch long for materials 2 inches thick and greater

(2) Rounded indications with dimensions greater than 1/8 inch for thicknesses less than 5/8 inch, and greater than 3/16 inch for thicknesses 5/8 inch and greater

(3) Four or more indications in a line separated by 1/16 inch or less edge-to-edge

(4) Ten or more indications in any 6 square inches of area that has a major dimension of no more than 6 inches, with the dimensions taken in the most unfavorable location relative to the indications being evaluated

7.2 Weld Indications

(1) Cracks or linear indications

(2) Rounded indications with dimensions greater than 3/16 inch

(3) Four or more rounded indications in a line separated by 1/16 inch or less, edge-to-edge

(4) Ten or more rounded indications in any 6 square inches of surface, with the major dimension of this area not to exceed 6 inches when the area is taken in the most unfavorable location relative to the indications being evaluated

8. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

9. RECORDS

(1) PSE&G shall receive copies of documents generated in accordance with this procedure in the examination report.

(2) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(3) The applicable data record is as follows:

SwRI-NDTR Form No.	Revision Date
17-11	1-3-79

SwRI	**SOUTHWEST RESEARCH INSTITUTE** **NUCLEAR PROJECTS** **OPERATING PROCEDURE**	SAM2-PT3 Rev. 0, Chg. 0 February 1990 Page 1 of 8

Title

VISIBLE WATER-WASHABLE LIQUID PENETRANT EXAMINATIONS

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-8	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: HC Inzamelli Date: 2/14/90

Technical Review: Joel A. Godin Date: 21 FEB 90

Approved By: David Frank Rosow Date: 2/26/90
Department Director

SwRI Form QA-3A-0

VISIBLE WATER-WASHABLE LIQUID PENETRANT EXAMINATIONS

SAM2-PT3

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure a proper water-washable liquid penetrant examination of nonporous austenitic or carbon steel materials in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) The water-washable method of liquid penetrant examination shall be employed as specified in the procedure for the detection of surface discontinuities in austenitic or carbon steel material.

(3) Components and welds to be examined are specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Material/Equipment Certification

(1) The penetrant materials used 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.

(2) Certified reports for all surface contact materials (except deionized water) to be used for penetrant examinations, giving batch numbers and analysis results, shall be obtained from the supplier. Copies of the certified reports shall be retained with the examination records.

(3) Equipment used to measure surface temperature shall have been calibrated and certified, and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

4.3 Materials and Equipment

The following materials and equipment shall be used for examinations performed in accordance with this procedure:

(1) Precleaner - Uresco Type K-410C, or MET-L-CHEK Type E-59

(2) Penetrant - Uresco Type P-303A, or MET-L-CHEK Type VP-30

(3) Penetrant Remover - Reactor-Grade Water

(4) Developer - Uresco Type D-495A, or MET-L-CHEK Type D-70

(5) A thermometer, certified as described in Subsection 4.2

4.4 Safety Precautions

Safety precautions in accordance with instructions furnished with each manufacturer's penetrant material shall be observed. Highly volatile solvents shall be used cautiously since the vapors may be toxic and the liquids may irritate the skin. Extreme care should be exercised in handling highly flammable solvents.

5. EXAMINATION METHOD

5.1 Surface Condition

(1) Unless otherwise specified by Public Service Electric and Gas Company (PSE&G), all penetrant examinations shall be performed on components in the final surface condition.

(2) The surface to be examined and adjacent areas for a minimum of 1 inch shall be free of scale, slag, dirt, grease, weld spatter, oil, paint, or any other extraneous matter that would obscure surface openings or otherwise interfere with the examination.

CAUTION

Blasting with shot or dull sand may peen discontinuities on the surface and shall not be used.

NOTE

Where surface conditions are not in accordance with Subsection 5.1 and correction is not feasible, SwRI will conduct the examination only at the request of Public Service Electric and Gas Company (PSE&G). The specific surface condition and its probable effect on the examination shall be noted on the SwRI Liquid Penetrant Examination Record.

5.2 Preexamination Cleaning

(1) The surface to be examined and adjacent areas within 1 inch shall be thoroughly washed with precleaner in such a manner that foreign material and contaminants are removed.

(2) The examination surface shall then be wiped dry with a lint-free cloth or absorbent paper, allowing a minimum of 5 minutes for complete evaporation.

5.3 Temperature Readings

The serial number of the thermometer used and the examination surface temperature (after the preexamination cleaning and before application of the penetrant) shall be recorded on the SwRI Liquid Penetrant Examination Record.

5.4 Application of Penetrant

(1) The penetrant shall be taken from a clean, controlled container to ensure its purity. It shall be applied by brushing or spraying and shall evenly cover all areas of the surface being examined.

(2) The allowable minimum and maximum penetrant dwell times shall be as follows:

Component Temperature (°F)	Dwell Time (Minutes)
60-70	20-30
71-90	10-30
91-100	10-20
101-125	10-15

(3) When examinations are to be performed on components whose temperature is below 60°F or above 125°F, this procedure shall be qualified in accordance with the requirements of Section V, Article 6, Subarticle T-660.

(4) The penetrant shall not be allowed to dry. If drying occurs, the penetrant shall be removed and the entire procedural process shall be repeated.

5.5 Removal of Excess Penetrant

(1) Excess penetrant shall be removed with a coarse water spray. Water pressures over 50 psi or water temperatures over 110°F shall not be employed.

(2) Extreme care shall be exercised to preclude the removal of penetrant from discontinuities. In situations where controlled water rinsing facilities are not available or water rinsing operations are not appropriate, the excess penetrant shall be removed by wiping the surface with a lint free cloth or absorbent paper dampened with reactor-grade water.

5.6 Drying

(1) The surface shall be completely dry prior to application of the developer.

(2) Drying time shall be a minimum of 5 minutes to a maximum of 30 minutes after the excess penetrant has been removed.

5.7 Application of Developer

(1) The wet developer shall be applied by spraying from a pressurized container.

(2) After sufficient agitation of the pressurized container to ensure that the particles in the suspension are dispersed, a smooth, uniform layer of the suspended powder shall be sprayed onto the surface.

(3) The developer shall be used sparingly. The proper developer thickness will dry to a thin, translucent layer. If the coating is too thick, it may mask indications. The examination surface shall be observed during the application of the developer to monitor the behavior of indications that tend to bleed-out profusely.

(4) Final interpretation of indications shall be made a minimum of 7 minutes to a maximum of 30 minutes after the developer has been applied.

6. EXAMINATION

6.1 Examination Areas

(1) Components, parts, and methods of examination shall be as specified in ASME Boiler and Pressure Vessel Code, Section XI, Tables IWB-2600 and IWC-2600.

(2) The examination area for circumferential and longitudinal welds shall be the weld and adjacent base material for a distance of 1t to either side of the weld fusion line.

(3) The examination area for branch connections shall include the weld and base material for a distance of 1t from the weld fusion line on the main run pipe and at least 2 inches of base material along the branch run.

(4) The examination area for support attachments shall include the weld and pipe or component base material for a distance of 1/2 inch from the weld fusion line, and the base material of the support attachment for a distance of two times the support thickness from the weld fusion line.

(5) Class 1 longitudinal welds shall be examined 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.

(6) Class 2 longitudinal welds shall be examined for the entire length between the fusion lines of the intersecting circumferential welds during preservice and inservice examinations.

(7) The examination for Class 1 socket welds in piping shall be the weld, 1t of base material on the pipe side, and 2.0 inches of base material on the fitting side.

6.2 Examination Methods

(1) Examinations shall be performed by placing the eye within 24 inches of, and at an angle no less than 30 degrees with the surface to be examined. A mirror may be used to improve the angle. In addition to general lighting, additional illumination of the examination area shall be provided at right and oblique angles to expose indications. The illumination shall be adequate to ensure no loss of sensitivity.

(2) If the examination surface is sufficiently large to preclude complete examination within the prescribed times, the surface shall be examined in suitable increments.

6.3 Postexamination Cleaning

The developer and penetrant shall be removed by wiping the surface thoroughly with cloths saturated with a suitable solvent or by spraying the surface thoroughly with reactor-grade water.

6.4 Reexamination

Indications that are believed to be nonrelevant shall be reexamined to verify whether actual defects are present. Surface conditioning may precede the reexamination. Nonrelevant indications and broad areas of pigmentation that would mask indications are unacceptable.

NOTE

Indications that are obviously nonrelevant, such as stamp marks or radiograph punch marks, shall be recorded only as a general remark on the SwRI Liquid Penetrant Examination Record.

7. RECORDING AND REPORTING CRITERIA

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SWRI-NDE2.

The following indications shall be recorded on the appropriate SwRI Liquid Penetrant Examination Record and reported to PSE&G:

7.1 Base Material Indications

(1) Linear Indications greater than 1/16-inch long for materials less than 5/8-inch thick, greater than 1/8-inch long for materials from 5/8-inch thick to under 2 inches thick, and 3/16-inch long for materials 2 inches thick and greater

(2) Rounded indications with dimensions greater than 1/8 inch for thicknesses less than 5/8 inch, and greater than 3/16 inch for thicknesses 5/8 inch and greater

(3) Four or more indications in a line separated by 1/16 inch or less, edge-to-edge

(4) Ten or more indications in any 6 square inches of area that has a major dimension of no more than 6 inches, with the dimensions taken in the most unfavorable location relative to the indications being evaluated

7.2 Weld Indications

(1) Cracks or linear indications

(2) Rounded indications with dimensions greater than 3/16 inch

(3) Four or more indications in a line separated by 1/16 inch or less, edge-to-edge

(4) Ten or more rounded indications in any 6 square inches of surface, with the major dimension of the area not to exceed 6 inches when the area is taken in the most unfavorable location relative to the indications being evaluated.

8. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

9. RECORDS

(1) PSE&G shall receive copies of documents generated in accordance with this procedure in the SwRI Examination Report.

(2) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(3) The applicable data record is as follows:

SwRI-NDTR Form No.	Revision Date
17-11	1-3-79

INTERIM CHANGE NOTICE

ICN No. 1

Page 1 of 1

Procedure No.: SAM2-MT1 Rev. No.: 0 Change No.: 0

Change The Following Paragraphs/Sentences To Read:

Add or Delete The Following Paragraphs/Sentences:

Add 7.1(5) For flywheel examinations, all indications 1/16-inch or greater shall be recorded.

ICN For Specific Application? ☒ Yes ☐ No If Yes, So State:

Flywheel examinations performed in accordance with Reg. Guide 1.14, Revision 1 dated August 1975

ICN For Specific Period? ☐ Yes ☒ No If Yes, ICN Expires

Verbal Approval Given? ☐ Yes ☒ No NPOP Rev./Chg. Req'd. ☐ Yes ☒ No

Prepared By: John R. Ingram... Date: 11 Jun 90

Technical Review: Russell ... Date: 11 June 90

Approved By: Grady L. Tagleder for DFR Date: 11 June 90

Department Director

SwRI Form QA-121-1

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SAM2-MT1 Rev. 0, Chg. 0 February 1990 Page 1 of 7

Title

DRY POWDER MAGNETIC PARTICLE EXAMINATION

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-7	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: John C. Ingarrell Date: 2/6/89

Technical Review: Jack A. Jordan Date: 13 FEB 90

Approved By: David Frank Rosow Date: 2/21/90
Department Director

SwRI Form QA-3A-0

DRY POWDER MAGNETIC PARTICLE EXAMINATION

SAM2-MT1

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure proper dry powder magnetic particle examinations of ferromagnetic materials in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) This procedure shall be utilized for the dry powder magnetic particle examination of ferromagnetic materials employing alternating current (AC) yoke techniques.

(3) Areas to be examined shall be ferritic components, longitudinal and circumferential welds, butt and fillet welds of branch connections, and support attachments as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Equipment

(1) AC electromagnetic yokes to be utilized shall have a lifting power of 10 pounds or greater at the maximum pole spacing that will be used.

(2) Dry magnetic particles shall be utilized as the examination medium. The color selected shall provide adequate contrast with the examination area.

(3) Dry magnetic particles shall be selected from the following:

(a) Magnaflux Red No. 8A Powder

(b) Magnaflux Grey No. 1 Powder

(c) Magnaflux Black No. 3A Powder

(d) Dry magnetic particles equivalent to those specified above may also be used.

(4) Devices used for application of dry magnetic particles shall be:

(a) Magnetic Particle Puffer Bottle, Model PB-1

(b) Magnaflux Pneumatic Applicator

4.3 Calibration Block

A ferromagnetic calibration block weighing a minimum of 10 pounds shall be used to confirm the lifting power of AC yokes.

5. CALIBRATION AND EXAMINATION METHODS

5.1 Calibration

(1) The applicable calibration block described in Subsection 4.3 of this procedure shall be used to verify the proper operation of the AC electromagnetic yoke:

(a) At the start of a series of examinations

(b) With any substitution of examination personnel

(c) With any substitution of power source

(d) At least every 4 hours during the examination

(e) At the finish of a series of examinations

(f) When the power operation of the yoke is in doubt

(2) All magnetic particle yoke verification times shall be entered on the SwRI Magnetic Particle Examination Record.

5.2 Examination Method

(1) Variable electromagnetic yoke pole spacing shall be a maximum of 9.0 inches, measured on the material surface between the centerline of the poles. The straight-line distance measured between the centerline of the poles shall be no greater than 6.0 inches and shall not exceed the distance used during calibration verification.

(2) The dry magnetic particles used shall be applied by lightly dusting a small quantity over the examination area. If a pneumatic applicator is used, the excess shall be removed with a gentle stream of air.

(3) The AC electromagnetic yoke shall remain activated during the application and removal of excess material.

(4) The AC electromagnetic yoke shall be applied three times on each portion of the examination area. The first application shall be on the centerline of the weld, when applicable, with both yoke poles on the weld. The second and third applications shall be conducted with the lines of magnetic flux approximately at right angles to the first application and separated by no more than 1/2 times the yoke pole spacing. Overlap shall be sufficient to ensure the entire examination area is covered (see Figure 1).

6. EXAMINATION

6.1 Examination Areas

Examinations shall be performed on materials in their completed condition.

6.1.1 Surface Preparation

(1) The examination area of welds and adjacent base materials shall be free from sharp surface irregularities such as deep valleys between stringer beads.

(2) The examination area shall be clean and dry. The examination area and a minimum of 1 inch on each side of the examination area shall be free from oil, sand, rust, grease, paint, slag, loose scale, or other surface conditions which may mask indications of unacceptable discontinuities.

(3) After slag removal, as-welded surfaces shall be considered suitable, without grinding, if the weld contour blends into the base material without undercutting.

NOTE

When surface conditions are not in accordance with the above and correction is not feasible, SwRI will conduct the examination only at the request of Public Service Electric and Gas Company (PSE&G). The specific surface condition and its effect on the examination shall be noted on the SwRI Magnetic Particle Examination Record.

6.1.2 Welds and Base Material

(1) The examination area for circumferential and longitudinal welds shall be the weld and adjacent base material for a distance of 1t to each side of the weld fusion line.

(2) The examination area for branch connections shall include the weld and the base material for a distance of 1t from the weld fusion line on the main run pipe and at least 2 inches of the base material along the branch run.

(3) The examination area for support attachments shall include the weld and base material of the main run pipe for a distance of 1/2 inch from the weld fusion line, and the base material of the support attachment for a distance of 2 times the support thickness from the weld fusion line.

(4) If the base material thickness is less than 1/2 inch, the examination area shall include the weld and adjacent base material for a distance of 1/2 inch on each side of the weld fusion line.

6.2 Reexamination

Broad areas of magnetic particle accumulation which could mask discontinuities are unacceptable and shall be cleaned and reexamined. Surface conditioning may precede the reexamination if necessary.

6.3 Postexamination Cleaning

(1) Arrangements shall be made with PSE&G for postexamination removal of dry magnetic particles.

(2) Demagnetization of the examination area is not required.

7. RECORDING AND REPORTING CRITERIA

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE2.

The following indications shall be recorded on the appropriate SwRI Magnetic Particle Examination Record and reported to PSE&G:

7.1 Base Material Indications

(1) Linear indications greater than 1/16 inch long for materials less than 5/8 inch thick, greater than 1/8 inch long for materials from 5/8 inch thick to under 2 inches thick, and 3/16 inch long for materials 2 inches thick and greater

(2) Rounded indications with dimensions greater than 1/8 inch for thicknesses less than 5/8 inch, and greater than 3/16 inch for thicknesses 5/8 inch and greater

(3) Four or more indications in a line separated by 1/16 inch or less edge-to-edge

(4) Ten or more indications in any 6 square inches of area that has a major dimension of no more than 6 inches, with the dimensions taken in the most unfavorable location relative to the indications being evaluated

7.2 Weld Indications

(1) Cracks or linear indications

(2) Rounded indications with dimensions greater than 3/16 inch

(3) Four or more rounded indications in a line separated by 1/16 inch or less, edge-to-edge

(4) Ten or more rounded indications in any 6 square inches of surface, with the major dimension of this area not to exceed 6 inches when the area is taken in the most unfavorable location relative to the indications being evaluated

8. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

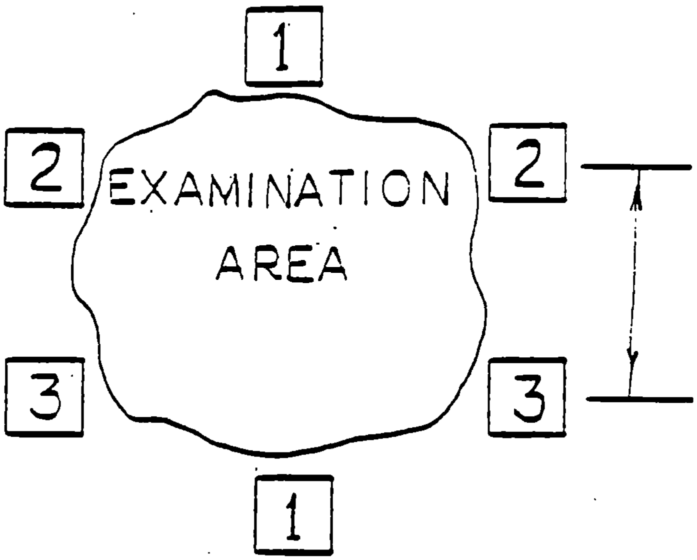
9. RECORDS

(1) PSE&G shall receive copies of documents generated in accordance with this procedure in the examination report.

(2) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(3) The applicable data records are as follows:

SwRI-NDTR Form No.	Revision Dated
17-12	11/26/79



Spacing between Examinations 2 and 3 should be approximately (but no greater than) 1/2 times the yoke spacing.

Figure 1. Yoke placement shown by approximate position and sequence

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SAM2-MT2 Rev. 0, Chg. 0 February 1990 Page 1 of 9

Title

FLUORESCENT MAGNETIC PARTICLE EXAMINATION

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-9	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: John Tromell(?) Date: 2/20/90

Technical Review: [signature] Date: 20 FEB 90

Approved By: David Frank Rosow(?) Date: 2/21/90

Department Director

SwRI Form QA-3A-0

FLUORESCENT MAGNETIC PARTICLE EXAMINATION

SAM2-MT2

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure proper fluorescent magnetic particle examinations of ferromagnetic materials in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

(2) This procedure shall be utilized for the fluorescent magnetic particle examination of ferromagnetic materials, employing alternating current (AC) yoke techniques.

(3) Areas to be examined shall be ferritic components, longitudinal and circumferential welds, butt and fillet welds of branch connections and support attachments as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

(4) Nuclear Regulatory Commission Regulatory Guide 1.65, "Materials and Inspections for Reactor Vessel Closure Studs" (where applicable)

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Equipment

(1) AC electromagnetic yokes to be utilized shall have a lifting power of 10 pounds or greater at the maximum pole spacing that will be used.

(2) A fluorescent magnetic suspension shall be utilized as the examination medium. It shall fluoresce with a color that will provide adequate contrast with the area being examined when illuminated by an ultraviolet lamp of suitable characteristics.

(a) Magnetic particles shall be suspended in a suitable liquid medium in the concentration recommended in SE-138, "Standard Method for Wet Magnetic Particle Inspection." Certified reports for magnetic particles, giving batch number and analysis results, shall be obtained from the supplier or by sample analysis of the batch to be used. Copies of the certified reports shall be retained with the examination records.

(b) Examinations shall be performed by utilizing Magnaglo No. 14AM or other aerosol-packaged fluorescent magnetic particle materials.

(c) If other than a premixed magnetic particle suspension material is used, the magnetic particle suspension shall be mixed in accordance with the manufacturer's instructions.

(3) A black light shall be used when conducting examinations in accordance with this procedure.

(4) The black light intensity at the surface under examination shall be determined using a Spectroline DM-365X Digital Long Wave Ultraviolet Meter

(a) At least every 8 hours

(b) Whenever lighting conditions change

(c) Whenever the work location is changed

(5) The black light intensity at the surface under examination shall be determined with the Spectroline DM-365X Digital Long Wave Ultraviolet Meter as follows:

(a) Darken the area to the condition that will prevail during the actual examination and place the sensor cell directly on the surface to be examined.

(b) After a black light warm-up time of no less than 5 minutes, move the black light from a minimum distance of 16 inches to a maximum distance of 22 inches from the sensor cell.

(c) Flip the power switch to the "POWER ON" or "MOMENTARY" position as desired.

(d) The value of the irradiance over the sensitive area of the sensor will be displayed in microwatts per square centimeter. A minimum of 800 microwatts per square centimeter is required.

(e) Record the reading in microwatts per square centimeter and the distance from the face of the black light on the applicable SwRI Examination Record.

(f) Return the power switch to the "OFF" position and remove the sensor from the light source.

(6) The thermometer to be used for measuring the component temperature shall be calibrated and certified and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

4.3 <u>Calibration Block</u>

A calibration block of a ferromagnetic material weighing a minimum of 10 pounds shall be used to confirm the lifting power of AC yokes.

5. <u>CALIBRATION AND EXAMINATION METHODS</u>

5.1 <u>Calibration</u>

(1) The applicable calibration block described in Subsection 4.3 shall be used to verify proper operation of the magnetic particle yoke when any of the following occurs:

(a) At the start of a series of examinations

(b) With any substitution of examination personnel

(c) With any substitution of power source

(d) At least every 4 hours during the examination

(e) At the finish of a series of examinations

(f) When the proper operation of the yoke is in doubt

(2) All magnetic particle yoke verification times shall be entered on the SwRI Magnetic Particle Examination Record.

5.2 <u>Examination Method</u>

(1) Examinations shall be made in a darkened area within the plant and shall commence approximately 5 minutes after the space is darkened, in order for the examiner's eyes to adjust.

(2) A black light shall be used to illuminate the examination area. A minimum of 5 minutes shall be allowed for warm-up.

(3) The examination surface temperature shall be measured and recorded on the SwRI Magnetic Particle Examination Record. The examiner shall assure the temperature is no higher than 135°F.

(4) The AC electromagnetic yoke shall be applied 3 times on each portion of the examination area. The first application is arbitrary but must encompass the area desired. The second and third applications shall be conducted with the lines of magnetic flux approximately at right angles to the first application and separated by no more than 1/2 times the yoke pole spacing. Overlap shall be sufficient to ensure the entire examination area is covered. See Figure 1.

(5) The magnetizing current shall remain on continuously during application of the magnetic suspension medium, while the excess is being drained, and during the observation.

(6) The magnetic particle suspension shall be applied by flooding the surface of the examination area and then allowing the excess to drain off.

NOTE

Agitate the aerosol containers to ensure that the particles are in suspension when dispensed.

(7) After draining, the area being examined shall be observed for indications of discontinuities while the fluorescent lamp is directed from various angles so that the entire surface of the area being examined is illuminated.

(8) Variable electromagnetic yoke pole spacing shall be a maximum of 9.0 inches, measured on the material surface between the centerline of the poles. The straight line distance measured between the centerline of the poles shall be no greater than 6.0 inches and shall not exceed the distance used during calibration verification.

(9) Demagnetization of the examination area is not required.

6. EXAMINATION

6.1 Examination Areas

Examinations shall be performed on materials in their completed condition.

6.1.1 Surface Preparation

(1) It shall be the responsibility of Public Service Electric and Gas Company (PSE&G) or PSE&G's representative to ensure that the examination area and a minimum of one inch on each side shall be clean, dry, free from oil, sand, rust, grease, paint, slag, loose scale, or other conditions which may mask the indication of unacceptable discontinuities.

(2) After slag removal, as-welded surfaces shall be considered suitable, without grinding, if the weld contour blends into the base material without undercutting.

(3) The examination area of welds and adjacent base materials shall be free from sharp surface irregularities such as deep valleys between stringer beads.

NOTE

When surface conditions are not in accordance with the above and correction is not feasible, SwRI will conduct the examination only at the request of PSE&G. The specific surface condition and its effect on the examination shall be noted on the SwRI Magnetic Particle Examination Record.

6.1.2 Welds and Base Material

(1) The examination area for circumferential and longitudinal welds shall be the weld and adjacent base material for a distance of 1t to either side of the weld fusion line.

(2) The examination area for branch pipe connections shall include the weld and adjacent base material for a distance of 1t from the weld fusion line on the main run pipe and at least 2 inches of the base material along the branch run.

(3) The examination area for support attachments shall include the weld and base material of the main run pipe for a distance of 1/2 inch from the weld fusion line, and the base material of the support attachment for a distance of two times the support thickness from the weld fusion line.

(4) If the base material thickness is less than 1/2 inch, the examination area shall include the weld and adjacent base material for a minimum distance of 1/2 inch on each side of the weld fusion line.

6.1.3 Threaded Components

NOTE

Extreme care should be exercised to prevent damage to threaded components during handling and examination.

The entire outer surface of studs, bolts, or cap screws and the respective nuts shall be examined.

6.2 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of fluorescent magnetic particle materials.

7. RECORDING AND REPORTING CRITERIA

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SWRI-NDE2. When conditions limit the area of examination, the limitation shall be recorded.

The following indications shall be recorded on the appropriate SwRI Magnetic Particle Examination Record and reported to PSE&G:

7.1 Base Material and Inservice Inspection of Reactor Pressure Vessel Closure Studs

(1) Any linear indications greater than 1/16-inch long for materials less than 5/8-inch thick; greater than 1/8-inch long for materials from 5/8-inch thick to under 2 inches thick; and 3/16-inch long for materials 2 inches thick and greater

(2) Rounded indications with dimensions greater than 1/8 inch for thicknesses less than 5/8 inch, and rounded indications with dimensions greater than 3/16 inch for thicknesses 5/8 inch and greater

(3) Four or more indications in a line separated by 1/16 inch or less, edge to edge

(4) Ten or more indications in any 6 square inches of area whose major dimension is no more than 6 inches with the dimensions taken in the most unfavorable location relative to the indications being evaluated

7.2 Weld Indications

(1) Cracks or linear indications

(2) Rounded indications with dimensions greater than 3/16 inch

(3) Four or more rounded indications in a line separated by 1/16 inch or less, edge to edge

(4) Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches when the area is taken in the most unfavorable location relative to the indications being evaluated

7.3 Preservice Inspection of Reactor Pressure Vessel Closure Studs

(1) Any linear, nonaxial indication

(2) Linear, axial indications greater than 1 inch in length

7.4 Cap Screws, Bolts and Studs Excluding Reactor Pressure Vessel Closure Studs

(1) Nonaxial indications 1/4 inch in length or greater

(2) Axial indications 1 inch in length or greater

8. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

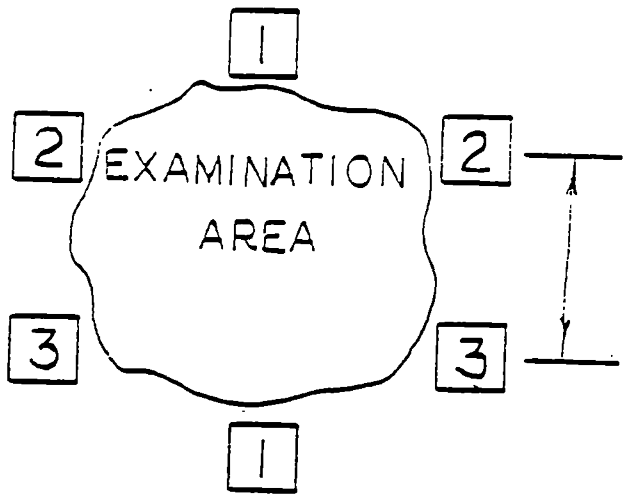
9. RECORDS

(1) PSE&G shall receive copies of documents generated in accordance with this procedure in the SwRI Examination Report.

(2) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(3) The applicable data record is as follows:

SwRI-NDTR Form No.	Revision Date
17-12	11-26-79



Spacing Between Examinations 2 and 3 Should Be Approximately (But No Greater Than) 1/2 Times the Yoke Spacing

Yoke Placement Shown by Approximate Position and Sequence

Figure 1

Title

MANUAL ULTRASONIC EXAMINATION OF PRESSURE PIPING WELDS

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-20	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: [illegible] Date: 5 FEB 90

Technical Review: [illegible] Date: 14 FEB 90

Approved By: David Frank Rosow Date: 2/21/90
Department Director

MANUAL ULTRASONIC EXAMINATION OF PRESSURE PIPING WELDS

SAM2-UT3

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps necessary to ensure a complete and accurate manual ultrasonic examination of pressure piping welds, and the adjacent base material, in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) Pressure piping welds and the adjacent base material in the nominal thickness range of greater than 0.4 to 5.0 inches shall be examined in accordance with this procedure.

(3) Manual, contact, pulse-echo, shear-wave angle-beam, and longitudinal-wave straight-beam ultrasonic techniques shall be utilized for the examination of clad or unclad piping welds and adjacent base material.

(4) Welds to be examined shall be circumferential and longitudinal pipe welds and butt and fillet welds of support attachments and branch connections as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1974 Edition with Addenda through Summer 1975, "Welding and Brazing Qualifications"

(4) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 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.

4.3 Basic Calibration Blocks

(1) 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 the same or equivalent P-number grouping as the production material as identified in Section IX of the ASME Boiler and Pressure Vessel Code. P-numbers P-1, P-3, P-4, and P-5 shall be considered equivalent for the purposes of this examination. The calibration material shall be determined by the production piping material to which the search unit is applied.

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

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

(4) 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.

(5) A single curved basic calibration block may 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.

(6) The curvature of the main run pipe shall be used to establish the requirements for the basic calibration block curvature for the examination of support attachment and branch connection welds.

4.4 Search Units

(1) Search unit sizes shall be selected from the following:

(a) 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" or 1" Round

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

(3) 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.

(b) Angle-Beam

Search unit sizes for carbon steel shall be selected from 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" x 1", 3/4" Round

(4) The nominal angle-beam shear-wave search unit frequency for the examination of carbon steel piping shall be 2.25 MHz.

(5) The nominal angle-beam shear-wave search unit frequency for examination of austenitic piping shall be as follows:

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

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

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

(8) 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.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 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. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(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.

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

5. CALIBRATION METHOD

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) The nominal piping production material thickness shall be used to determine the correct basic calibration block. Sometimes geometric restrictions such as piping or components that are thicker than the nominal pipe thickness, examinations limited to one side of the weld, or wide weld crowns are encountered. In such cases, it may be necessary to use additional vee-path positions and larger screen sizes to obtain the required coverage of the weld. The Level II or Level III examiner shall be responsible for assuring that complete coverage of the examination area is obtained.

(4) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

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

5.1 Calibration for Circumferential Butt Welds

5.1.1 Straight-Beam Distance Calibration

Observing back reflections from the applicable reference block, set up the required linear sound path distance along the screen baseline, which shall be the shortest applicable size to include at least 1/4t beyond the thickest production material to which the search unit is applied.

5.1.2 Angle-Beam Distance Calibration

(1) Observing radius echoes from the applicable reference block, set up the required linear sound path distance along the screen baseline, which shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

(2) When the same instrument is used for both 45° and 60° degree examinations, the screen distance calibration shall be conducted as follows:

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

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

(c) Without changing the calibrated screen distance, repeat step (b) with the 60° search unit.

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

5.1.3 Straight-Beam Distance Amplitude Correction

DAC shall be conducted by utilizing responses from the basic calibration holes.

(1) Production Material 1 Inch or Less in Thickness

(a) Position the straight-beam search unit to obtain maximum response from the 1/2T hole and set this response to 50% ±5% of full screen height (FSH).

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

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

(2) Production Material Greater Than 1 Inch in Thickness

(a) 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

(b) Set this response to 50% ±5% of FSH and mark the amplitude on the screen.

(c) Without changing the gain controls, obtain maximum response from the remaining calibration holes; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/4T beyond the last qualified calibration point.

5.1.4 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 perpendicularly to the axis of the basic calibration block.

(1) Unclad Material 1 Inch or Less in Thickness (45° and 60° DAC)

(a) Position the 45° search unit to obtain a maximum response from the 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

(b) Set this response to 75% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(c) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(d) Repeat steps (a) through (c) using a 60° search unit.

EXCEPTIONS

If the configuration of the weld is such that the 60° search unit sound beam is not directed into the weld root on the straight pass, a 14/8 vee-path calibration shall be accomplished with a 45° search unit. Indications detected in the calibrated area shall be recorded.

If the configuration of the weld is such that a 45° 14/8 vee-path examination and a 60° 10/8 vee-path examination fail to cover the entire weld volume, a 14/8 vee-path calibration shall be accomplished with both a 45° and a 60° search unit, and indications detected in the calibrated area shall be recorded.

(2) Unclad Material Greater Than 1 Inch to 3 Inches in Thickness (45° and 60° DAC)

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

Hole	45° Vee-Path Positions
1/4T	7/8, 9/8
3/4T	3/8, 5/8

(b) Set this response to 75% ±5% of FSH and mark the amplitude on the screen.

(c) Without changing the gain controls, obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(d) Repeat steps (a) through (c) with a 60° search unit utilizing the following vee path positions:

Hole	60° Vee-Path Positions
1/4T	1/8, 7/8
3/4T	3/8, 5/8

EXCEPTIONS

If the configuration of the weld is such that the 45° full vee-path examination fails to cover the entire weld volume, a 9/8 vee-path calibration shall be accomplished with the 60° search unit.

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

(3) Unclad Material Greater Than 3 Inches in Thickness (45° and 60° DAC)

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

Hole	Vee-Path Positions
1/4T	7/8
3/4T	3/8, 5/8

(b) Set this response to 75% ±5% of FSH and mark the amplitude on the screen.

(c) Without changing the gain controls, obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(d) Repeat steps (a) through (c) using a 60° search unit utilizing the following vee-path positions:

Hole	60° Vee-Path Positions
1/4T	1/8
3/4T	3/8, 5/8

(4) Clad Material Greater Than 0.4 Inch in Thickness (Examined From the Unclad Side with 45° and 60° DAC)

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

Hole	45° Vee-Path Positions
1/4T	1/8
1/2T	2/8
3/4T	3/8

(b) Set this response to 75% ±5% of FSH and mark the amplitude on the screen.

(c) Without changing the gain controls, obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(d) Repeat steps (a) through (c) using a 60° search unit.

5.2 Calibration for Support Attachment, Branch Connection, and Longitudinal Seam Welds

5.2.1 Straight-Beam Distance Calibration

The straight-beam distance calibration shall be the same as that described in Paragraph 5.1.1.

5.2.2 Angle-Beam Distance Calibration

The angle-beam distance calibration shall be the same as that described in Paragraph 5.1.2, using only the 45° search unit.

5.2.3 Straight-Beam Distance Amplitude Correction

The straight-beam DAC shall be the same as that described in Paragraph 5.1.3.

5.2.4 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.

(1) Unclad Material 1 Inch or Less in Thickness (45° DAC)

(a) Position the 45° search unit to obtain a maximum response from the 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, 14/8

(b) Set this response to 75% ±5% of FSH and mark the amplitude on the screen.

(c) Without changing the gain controls, obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

EXCEPTION

If the configuration of the weld is such that coverage of the entire weld volume is attained with a 10/8 vee-path calibration, a 14/8 calibration is not required.

(2) Unclad Material Greater Than 1 Inch in Thickness (45° DAC)

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

Hole	Vee-Path Positions
1/4T	7/8, 9/8
3/4T	3/8, 5/8, 11/8

(b) Set this response to 75% ±5% of FSH and mark the amplitude on the screen.

(c) Without changing the gain controls, obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

EXCEPTION

If the material is greater than 3 inches in thickness and the configuration of the weld is such that coverage of the entire weld volume is attained with a 9/8 vee-path calibration, an 11/8 calibration is not required.

(3) Clad Material Greater Than 0.4 Inch in Thickness (Examined from the Unclad Side with a 45° DAC)

This calibration shall be the same as that described in Paragraph 5.1.4(4), steps (a) through (c), using only a 45° search unit.

5.3 Secondary DAC Calibrations

Each point on the DAC curve shall appear at a minimum of 20% of FSH, or a secondary DAC curve shall be constructed as follows:

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

(2) The DAC point at 20% of FSH or greater, adjacent to a DAC point that falls below 20% of FSH, shall be brought to the primary reference level and marked on the instrument screen. The adjacent point(s), previously at less than 20% of FSH, 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 20% of FSH, the next highest point shall be brought to the primary reference level and marked on the instrument screen. The other points previously at less than 20% of FSH shall be marked on the screen and all points connected with a smooth curved line.

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.

5.4 Calibration Verification

5.4.1 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) Prior to a series of examinations

(2) With any substitution of the search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.4.2 Calibration Changes

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

(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% 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.

5.4.3 Recalibration

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

(1) Search unit transducer or wedge

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

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

5.4.4 Verification of Calibration Reflectors at Scanning Speeds

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors is readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed:

"Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination Areas

(1) Pressure piping 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. Base material shall be examined for a distance of 1t from the fusion line on each side of the circumferential and longitudinal weld and 1t from the fusion line on the main run pipe side of the butt or fillet weld of support attachments or branch connections.

(2) Longitudinal welds shall be examined for 12 inches from the fusion line of the intersecting circumferential weld during inservice examinations.

6.2 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.

6.3 Indication Length Zero Reference (L_0) Location

Areas to be examined in accordance with this procedure shall have an L_0 marked in accordance with the applicable revision of SwRI NPOP SwRI-NDE7.

6.4 Scanning

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

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

(a) 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).

(b) Add 6 dB 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 any method that yields a signal response within ±2 dB of 80% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

(3) Scanning overlap shall be a minimum of 25% of the search unit piezoelectric element dimension perpendicular to the direction of the scan for austenitic material and 10% overlap for ferritic material.

(4) The search unit movement rate shall not exceed 3 inches per second for austenitic material and 6 inches per second for ferritic material.

6.5 Lamination Scan, Attenuation, and Thickness Measurements

NOTE

Screen distance calibration for lamination scans and thickness measurements shall be conducted in accordance with Paragraph 5.1.1 for circumferential welds and Paragraph 5.2.1 for support attachment, branch connection, and longitudinal welds.

6.5.1 Longitudinal Attenuation Measurements

(1) A straight-beam search unit, as described for attenuation measurements in Subsection 4.4, shall be placed on the appropriate basic calibration block. Obtain a backwall reflection signal between 50% and 90% of FSH. Record the signal amplitude and instrument gain settings on the appropriate SwRI Sonic Instrument Calibration Record and 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.

(2) Place the straight-beam search unit on the examination surface adjacent to L_0 on the base material away from the heat-affected zone 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. Locations of attenuation measurements which

cannot be taken adjacent to L_0 shall also be recorded. Measurements shall be taken at the following locations:

(a) One on each side of the circumferential and longitudinal weld

(b) One adjacent to L_0 on the main run pipe base material for support attachment and branch connection welds

NOTES

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

No attempt shall be made to take attenuation measurements on clad piping.

6.5.2 Base Material Lamination Scan

(1) A lamination scan using straight-beam longitudinal-wave and covering the entire area through which the angle beam is to be passed shall be performed before the angle-beam examination. Scanning sensitivity of the first back reflection shall be maintained at an amplitude of between 50% and 90% of FSH.

(2) To record an intermediate indication, a back reflection signal shall be obtained from an indication-free area and set 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. Areas of total loss of back reflection accompanying the intermediate echo shall also be recorded.

6.5.3 Thickness Measurements

Thickness measurements shall be taken at a minimum of three points adjacent to L_0 for longitudinal and circumferential welds (one on the centerline of the weld and one in the base material on each side of the weld) and at a minimum of 2 points adjacent to L_0 for support attachment and branch connection welds (one on the base material of the main run pipe and one on the branch connection or support attachment). Locations of measurements that cannot be taken adjacent to L_0 shall be recorded on the appropriate SwRI Examination Record. Measurements shall be taken by observing the position of the backwall reflection on the instrument screen.

6.6 Examination of Circumferential and Longitudinal Butt Welds in Piping

NOTE

Calibration for angle-beam examinations shall be in accordance with Paragraphs 5.1.2 and 5.1.4 for circumferential welds and Paragraphs 5.2.2 and 5.2.4 for longitudinal welds.

6.6.1 Angle-Beam Examination for Indications Parallel with the Weld

(1) Angle-beam examinations for circumferential welds shall be conducted as required using 45° and 60° refracted shear waves from each side of the weld. For this examination, the sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld.

(2) Angle-beam examinations for longitudinal welds shall be accomplished using a 45° refracted shear wave from each side of the weld. For this examination, the sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld.

6.6.2 Straight-Beam Weld Examinations

(1) A 45° and 60° angle-beam examination shall be conducted from both sides of the circumferential weld. Any areas of the weld not receiving complete coverage from both sides shall be examined from one side of the weld, if possible, with a 45° and 60° shear wave and a straight beam applied to the surface of the weld crown in the affected areas.

(2) A 45° angle-beam examination shall be conducted 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, if possible, with a 45° shear wave and a straight beam applied to the surface of the weld crown in the affected areas.

(3) Calibration for the straight-beam search unit shall be in accordance with Paragraphs 5.2.1 and 5.2.3.

6.6.3 Angle-Beam Examination for Indications Perpendicular to the Weld

(1) An angle-beam examination shall be conducted on each weld by placing a 45° shear-wave search unit on the weld with the sound beam directed into and parallel with the weld to detect indications perpendicular to the weld. The search unit shall then be turned 180° and the scan repeated.

(2) For austenitic materials, the search unit shall then be placed on the base metal with the sound beam directed tangentially 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 circumferential or longitudinal 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.

6.6.4 <u>Angle-Beam Examination for Indications in Austenitic Base Material Perpendicular to the Weld</u>

An angle-beam examination shall be conducted on 1t of base material adjacent to each circumferential or longitudinal weld using a 45° 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 on both sides 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.

6.7 <u>Examination of Butt and Fillet Welds of Branch Connections and Support Attachments</u>

<u>NOTES</u>

Angle-beam calibration for these examinations shall be in accordance with Paragraphs 5.2.2 and 5.2.4.

Examinations from main run pipe side of clad piping, as specified in this procedure, shall be conducted only on welds of set-in type branch connections.

Examinations from main run pipe side of clad piping shall not be conducted on welded-on pipe supports or lugs.

6.7.1 <u>Angle-Beam Examination for Indications Parallel with the Weld</u>

An angle-beam examination shall be accomplished using a 45° 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.

6.7.2 <u>Angle-Beam Examination for Indications Perpendicular to the Weld</u>

For branch connection butt welds, the angle-beam examinations for indications perpendicular to the weld shall be the same as the examination described in Paragraphs 6.6.3 and 6.6.4 and shall be conducted only on the weld and on the main run pipe side of the weld.

6.7.3 Straight-Beam Examination of Welds

A straight-beam examination shall be performed on the surface of the weld crown when possible. This calibration shall be in accordance with Paragraphs 5.2.1 and 5.2.3.

6.8 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) Indications beyond the 6/8 vee-path position shall not be recorded while conducting 60° examinations calibrated in accordance with Paragraph 5.1.4(1) when complete coverage of the weld volume is obtained with the 45° search unit and the 60° search unit sound beam is directed into the weld root on the straight pass.

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

(4) Indications 50% or greater of the reference level attributable to geometry shall be recorded only once, even if the amplitude of the indication fluctuates above and below the required recording amplitude along the weld. These indications shall be investigated by a Level II or a Level III examiner to determine the shape, identity, and location of the reflector.

(5) If indications that have been recorded as geometry have been investigated and found to be nongeometric reflectors, the entire weld shall be reexamined and all nongeometric reflectors and other reflectors not previously recorded at least once shall be recorded.

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

(7) All ultrasonic reflectors (regardless of signal amplitude), not attributable to geometry, shall be recorded and investigated by a Level II or a Level III examiner to determine the shape, identity, and location of the reflector. Examples of nongeometric reflectors 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.

(8) Indications investigated and found to be other than geometrical in nature, regardless of the amplitude, shall be reported to PSE&G for evaluation.

(9) Scanning limitations shall be recorded.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with Article IWA-3000, Section XI, or the applicable ASME Boiler and Pressure Vessel Code.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI-NDTR Form No.	Revision Date
17-18	7/31/75
17-19	12/1/83
17-25	3/14/79
17-48	5/9/77
17-49	5/9/77

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Title

MANUAL ULTRASONIC EXAMINATION OF REACTOR COOLANT PUMP FLYWHEELS

EFFECTIVITY AND APPROVAL

Page	Change	Date
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Prepared By: SR Ingamells Date: 2/13/90

Technical Review: Joel A. Godwin Date: 26 FEB 90

Approved By: David Frank Rosow Date: 2/26/90

Department Director

SwRI Form QA-3A-0

MANUAL ULTRASONIC EXAMINATION OF REACTOR COOLANT PUMP FLYWHEELS

SAM2-UT6

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure a proper ultrasonic examination of reactor coolant pump motor flywheels in accordance with the applicable documents stated herein.

(2) Reactor coolant pump motor flywheels in the thickness range of 3 to 9 inches shall be examined utilizing shear-wave angle-beam and longitudinal-wave straight-beam, manual, contact, pulse-echo ultrasonic techniques.

(3) Reactor coolant pump motor flywheels to be examined shall be as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(2) Nuclear Regulatory Commission (NRC) Regulatory Guide 1.14, Revision 1, dated August 1975, "Reactor Coolant Pump Flywheel Integrity"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Block

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

4.3 Basic Calibration Block

The basic calibration block thickness shall be within ±1 inch of the actual flywheel thickness. Side-drilled basic calibration reflectors shall be placed in a block of the same or equivalent P-grouping as the flywheel to be examined. P-numbers P-1, P-3, P-4, and P-5 shall be considered to be equivalent for the purposes of this examination. The diameter of the basic calibration reflectors shall be determined by the actual thickness of the flywheel and Figure T-533(a), Article 5, Section V of the ASME Boiler and Pressure Vessel Code.

4.4 Search Units

(1) Search units shall be selected from the following:

Search Unit Type	Search Unit Size
Straight-Beam	1" round, or 1-1/8" round
Angle-Beam	1/2" x 1", 1" x 1", or 1" round

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

(3) Search unit wedges shall be fabricated to produce 45° ±2° refracted shear-waves as demonstrated on the IIW block. Other angles, as required, may be used to augment the examinations.

(4) The nominal search unit frequency shall be 2.25 MHz.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 Couplant

(1) USP-grade glycerine or deionized water shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure. Deionized water, when used, shall be supplied by Public Service Gas and Electric Company (PSE&G).

(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.

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

5. CALIBRATION

5.1 Calibration Method

(1) The ultrasonic calibration shall be completed prior to the examination.

(2) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

(3) The FREQ MHZ control shall be turned to 2.

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

5.1.1 Straight-Beam Distance Calibration

(1) The screen distance calibration chosen shall be the shortest applicable size that includes at least 1/4t past the nominal production material thickness.

(2) Observing back reflections from the applicable reference block, set up the required linear sound path distance along the screen baseline.

5.1.2 Angle-Beam Distance Calibration

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

(2) Observing the radius echoes from the applicable reference block, set up the required linear sound path distance along the instrument screen baseline.

5.1.3 Angle-Beam Distance Amplitude Correction (1/2 Vee-Path)

Distance amplitude correction (DAC) curves shall be established by obtaining the maximum response from the basic calibration holes.

> **NOTE**
>
> The 1/2 vee-path calibration shall be performed from the unclad side of clad basic calibration blocks.

A 1/2 vee-path calibration shall be constructed as follows:

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

Holes	Vee-Path Positions
1/4T	1/8
1/2T	2/8
3/4T	3/8

(2) Set this signal to 75% ±5% of full screen height (FSH) and mark this amplitude on the instrument screen.

(3) Without changing the gain controls, obtain maximum response from the remaining calibration holes; mark and join all amplitude points with a smooth curved line extrapolated to the 4/8 vee-path position.

5.1.4 Angle-Beam Distance Amplitude Correction (Full Vee-Path)

NOTE

The full vee-path calibration shall be performed from the clad side of basic calibration blocks.

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

Holes	Vee-Path Positions
3/4T	5/8
1/2T	6/8
1/4T	7/8

(2) Set this signal to 75% ±5% of FSH and mark this amplitude on the screen.

(3) Without changing the gain controls, obtain maximum response from the remaining calibration holes; mark and join all amplitude points with a smooth curved line extrapolated to the 4/8 vee-path position from the 5/8 vee-path position and from the 7/8 vee-path position to the 8/8 vee-path position.

(4) With the instrument gain controls adjusted in accordance with (3) above, obtain a signal from the 5/8 vee-path position from the UNCLAD side of

the basic calibration block and record the dB difference required to adjust this signal to 75% ±5% of FSH. This difference shall be used during the evaluation of nongeometric indications, if any, recorded during examinations. The dB difference shall be recorded on the appropriate SwRI Instrument Calibration Record.

NOTE

The screen size used for this calibration should be the same as that used for the 1/2 vee-path calibration. For this purpose, the DAC curve can be delayed to the left side of the screen, provided the 4/8 to 8/8 DAC is encompassed on the instrument screen.

5.2 Calibration Verification

5.2.1 Frequency of Instrument Calibration 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 search unit cable

(3) With any substitution of the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.2.2 Calibration Changes

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

(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% 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 Flywheel Ultrasonic Examination Record.

5.2.3 Recalibration

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

(1) Search unit wedge or transducer

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

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

5.2.4 Verification of Calibration Reflectors

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

> **NOTE**
>
> Attenuation measurements shall not be performed.

6.1 Examination Areas

(1) A 45° examination shall assure 100% coverage of the bore area or any portion that is accessible and shall be conducted from both sides of the flywheel, if possible. Determination of accessibility for examination will depend on each particular flywheel installation.

(2) A lamination scan shall assure 100% coverage of the flywheel or any portion that is accessible. If the flywheel assembly is composed of two or more bolted sections or is laminated, the lamination scan shall be conducted from both outer surfaces, if accessible.

6.2 Surface Condition

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

6.3 Scanning Parameters

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

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

(a) With the instrument at the primary reference level manipulate the search unit on the calibration block to obtain a signal from a reflector (machined notch) of 40% of FSH.

(b) 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 any method which yields a signal response within ±2 dB of 80% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period of all scanning at 2 times the reference level sensitivity.

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

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

6.4 Scanning

6.4.1 Lamination Scan

(1) Before the shear-wave examination, a lamination scan using longitudinal wave shall be performed, covering 100% of the flywheel or such a portion that is accessible. Screen distance calibration for this examination shall be conducted in accordance with Paragraph 5.1.2. Scanning sensitivity shall be as required to maintain the first back reflection at an amplitude of between 50% and 90% of FSH.

(2) To record an intermediate indication, the first back wall reflector shall be obtained from an indication free area and adjusted to 75% ±5% of FSH. The intermediate indication shall be recorded on the SwRI Flywheel Straight Beam Lamination Record when its amplitude is equal to 50% of the initial back reflection and accompanied by a 50% loss of back reflection. Areas of total loss of back reflection accompanying the intermediate echo shall also be recorded.

6.4.2 Angle-Beam Examination

A 45° shear-wave shall be applied from the appropriate surface(s) so that it strikes at the intersection of the bore and the far surface tangent to the bore. The examination shall be conducted in a clockwise and a counterclockwise direction. Scanning performed in a direction tangential to the flywheel bore shall be such that as much as practicable of the bore is examined.

6.5 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Ultrasonic reflectors producing a response 50% or greater of the reference level shall be recorded.

(2) A W_0 and a L_0 shall be established, and their locations shall be described on the appropriate SwRI Flywheel Ultrasonic Examination Record. Indications recorded shall be referenced to the established W_0 and L_0 locations. L and W measurements shall be recorded in inches and common fractions to the nearest 1/16 inch.

(3) Indications producing a response 100% or greater of the reference level shall be investigated by a Level II or a Level III examiner to determine the shape, identity, and location of the reflector (i.e., plot, profile, review of radiographs, etc.).

(4) Indications 100% or greater of the reference level investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

(5) Scanning limitations shall be recorded.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel in accordance with NRC Regulatory Guide 1.14, Revision 1, as specified in Paragraph 2(1) of this procedure. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI NDTR Form No.	Revision Date
17-19	12-01-83
17-23	07-31-75
17-24	07-31-75
17-25	03-14-79

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Title

MANUAL ULTRASONIC EXAMINATION OF NOZZLE INSIDE RADIUS SECTIONS FROM VESSEL BASE MATERIAL

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Prepared By: John C. Inganelli Date: 2/13/90

Technical Review: Joel A. Godwin Date: 26FEB90

Approved By: David Frank Rosow Date: 2/27/90
Department Director

SwRI Form QA-3A-0

MANUAL ULTRASONIC EXAMINATION OF NOZZLE INSIDE RADIUS SECTIONS FROM VESSEL BASE MATERIAL

SAM2-UT11

1. PURPOSE

(1) This procedure provides the technical information and detailed steps required to ensure a proper ultrasonic examination of inner radius sections of nozzles in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) The examination of forged nozzle inner radius sections from the vessel base material is described in this procedure and shall be conducted as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

(3) Shear-wave or longitudinal-wave angle-beam, as required, and manual, contact, pulse-echo ultrasonic techniques shall be employed from the vessel outside surface.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition, with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition, with Addenda through Summer 1975, "Nondestructive Examination"

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1974 Edition, with Addenda through Summer 1975, "Welding and Brazing Qualifications"

(4) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification.

4.2 Reference Block

The reference block used for screen distance calibration and verification shall be of the same basic material as the production material, carbon steel, and shall be an IIW block.

4.3 Basic Calibration Block

The calibration notches shall have a minimum depth of 0.075 inch up to a maximum depth of 2.5% t. The thickness of the vessel wall or the nozzle reinforcement, whichever is less, shall be used to establish "t" for calculating notch depth. Basic calibration blocks shall be 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 are considered to be equivalent for the purposes of this examination. The basic calibration block material and thickness shall be determined by the production material to which the search unit is applied. The notch reflectors shall be in accordance with the approved drawings of the basic calibration block contained in the applicable SwRI Examination Plan.

4.4 Search Units

(1) Search unit size shall be 1/2" x 1" or 1" round.

(2) Search unit wedges shall be fabricated to produce a refracted longitudinal-wave or a refracted shear-wave, as required by Appendices A-1 and A-2. The search unit angle shall be within ±2° of the required angle.

(3) The nominal search unit frequency shall be 2.25 MHz.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 Couplant

(1) USP-grade glycerine or deionized water shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(2) 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.

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

5. CALIBRATION METHOD

(1) The ultrasonic instrument calibration shall be completed prior to the examination.

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

(3) The FREQ MHZ control shall be turned to 2.

(4) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

5.1 Shear-Wave Distance Calibration

The shear-wave distance calibration shall be conducted as follows:

(1) Position the search unit on the 4-inch dimension of an IIW block, observe radius echoes, and set up a 10- or 20-inch linear sound path distance along the baseline of the screen. The shortest screen distance size which encompasses the last calibration point shall be utilized.

5.2 Longitudinal-Wave Distance Calibration

The search unit wedge shall be removed from the search unit prior to the preliminary longitudinal-wave distance calibration shown below:

(1) Position the search unit on the 4-inch dimension of an IIW block, observe the back reflections, and set up a 10- or 20-inch linear sound path distance along the baseline of the instrument screen. The shortest screen distance size which encompasses the last calibration point shall be utilized.

(2) Remount the search unit on the wedge described in Subsection 4.4 and position it on the basic calibration block.

(3) Maximize the signal from the nearest appropriate notch and physically measure this metal path distance.

(4) Adjust only the DELAY control to position the signal at the appropriate metal path distance on the screen baseline.

5.3 Distance Amplitude Correction

Distance Amplitude Correction (DAC) curves shall be constructed utilizing the responses from the appropriate basic calibration notches to obtain the metal paths designated in the appendices as follows:

(1) Position the search unit, mounted on the wedge described in Subsection 4.4, on the basic calibration block and obtain a maximum response from the applicable calibration notch which produces the highest amplitude.

(2) Set this signal to the primary reference amplitude of 75% ±5% of full screen height (FSH) and mark this amplitude on the screen.

(3) Obtain maximum response from the remaining applicable calibration notches; mark and join all amplitude points with a smooth curved DAC line.

5.4 Secondary DAC Calibration

Each point on the DAC curve shall appear at a minimum of 20% of FSH or 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 20% of FSH or greater, next to a DAC point that falls below 20% of FSH, shall be brought to 80% of FSH and marked on the instrument screen. The other point(s), previously at less than 20% FSH, 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.

EXCEPTION

When the first DAC point is the only point above 20% of FSH, the next highest point shall be brought to the primary reference level and marked on the instrument screen. The other points, previously at less than 20% of FSH, shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall also be recorded.

5.5 Calibration Verifications

5.5.1 Sweep Range and DAC Curve Verification

Sweep range calibration shall be verified on the IIW block and DAC curve calibration shall be verified on the appropriate basic calibration block when any of the following occurs:

(1) Prior to a series of examinations

(2) With any substitution of the search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.5.2 Calibration Changes

(1) Perform the following if any calibration point has decreased more than 20% or 2 dB in amplitude, or any point on the sweep line has moved more than 5% of full screen width:

(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 the examinations have been voided.

(2) Perform the following if any calibration point 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.

5.5.3 Recalibration

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

(1) Search unit wedge or transducer

(2) Examination personnel

(3) Couplant

(4) Ultrasonic instrument

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

5.6 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signals from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Sonic Instrument Calibration Record and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination Area

The specific nozzle inner radius to be examined and the metal path distances to the inner radius shall be as listed in Appendix A and the SwRI Examination Plan. The inner radius section of nozzles shall be examined from the vessel outside surface.

6.2 Surface Conditions

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

6.3 Reference Points for Physical Measurements

The reference circle (Appendix A) shall be marked around each nozzle. The L_0 of each nozzle shall be entered on the appropriate SwRI Examination Record. The 0°, 90°, 180°, and 270° positions shall be marked around the nozzle. The azimuth locations marked on the shell or head shall be numbered in a clockwise direction as viewed from the vessel exterior. Radial lines extended to intersect the reference circle shall be drawn through each of these azimuth points.

6.4 Scanning

(1) When practicable, examination shall be performed at an instrument gain setting of 2 times the reference level sensitivity, or a 6 dB increase.

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

(a) 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 (machined notch) of 40% of FSH.

(b) 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 any method which yields a signal response within ±2 dB of 80% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

(3) Specific scanning information for the examination of the nozzle inner radius section shall be as specified in Appendix A.

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

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

(6) Attenuation measurements shall not be taken.

NOTE

Cladding ripple echoes occur at the same metal path distance as flaws in the nozzle inner radius. A flaw can be distinguished from cladding ripple by the greater amplitude of the flaw compared to the amplitude of the cladding ripple at the same location.

6.5 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in Appendix B.

(2) Ultrasonic reflectors producing a response 50% or greater of the reference level shall be recorded on the applicable SwRI Examination Record.

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

(4) Indications 100% or greater of the reference level investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

(5) Scanning limitations shall be recorded.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI NDTR Form No.	Revision Date
17-19	12-01-83
17-109	02-18-82

APPENDIX A-1

Examination Areas: Inner radius sections of steam generator inlet and outlet nozzles at Salem Generating Station, Unit 2

Examination Preparations: A reference circle shall be marked around each nozzle. The location shall be as follows:

Steam Generator Inlet Nozzles: 1.75 inches from the nozzle edge of the nozzle-to-vessel blend radius, on the conical section of nozzle

Steam Generator Outlet Nozzles: 3.25 inches from center of blend radius on the nozzle side of the blend radius.

Search Unit Angles: Search unit wedges shall be fabricated to produce the following angles:

Steam Generator Inlet Nozzles: 34° refracted longitudinal-wave angle beam

Steam Generator Outlet Nozzles: 30° refracted longitudinal-wave angle beam

Examination: The search unit shall be placed on the reference circle. One scan shall be made in a clockwise and one in a counterclockwise direction. The search unit skew angle shall be as follows:

Steam Generator Inlet Nozzles: Skew 7° toward bore of nozzle away from the vessel inner surface. The metal path to the inner radius is approximately 16.6 inches.

Steam Generator Outlet Nozzles: Skew 27° toward bore of nozzle away from the vessel inner surface. The metal path to the inner radius is approximately 14.4 inches.

APPENDIX A-2

Examination Areas:

The inner radius of the pressurizer relief nozzles at Salem Generating Station, Unit 2, shall be examined.

Examination Preparations:

Reference circles shall be located on the vessel base material as follows:

4-Inch Relief Nozzle. The reference circle shall be located 8-5/16 inches from the center of the bore.

6-Inch Relief Nozzle. The reference circle shall be located at 9-1/2 inches from the center of the bore.

Search Unit Angles:

Search unit wedges shall be fabricated to produce 53° ±2° refracted shear waves.

Examination:

4-Inch Relief Nozzle. The examination shall be conducted in a clockwise and counterclockwise direction from the reference circle with the search unit directed at a skew angle of 10° from the reference circle. The metal path to the inner radius is approximately 7-3/4 inches.

6-Inch Relief Nozzle. The examination shall be conducted in a clockwise and counterclockwise direction from the reference circle with the search unit directed at a variable skew angle of 14° to 15° from the reference circle. The metal path to the inner radius is approximately 8 inches.

APPENDIX B

Measurements

L measurements shall start at L_0, the junction of the vessel wall and blend radius, and shall be made towards the nozzle to the axial center of the search unit.

W measurements shall start at W_0, the top centerline of the nozzle, and shall be made clockwise as viewed from a position perpendicular to the vessel surface along the junction of the blend radius and vessel wall to the exit point of the search unit.

L and W measurements shall be recorded in inches and common fractions to the nearest 1/16 inch.

Metal path measurements shall be made to the nearest 0.1 inch at each location requiring W measurements.

Indications 50% and Greater

Required L	W_{max} and W_{max} M.P.
L_1 and L_2 at 50%	Not Required
L_{max}	X

Title

MANUAL ULTRASONIC EXAMINATION OF FERRITIC PRESSURE VESSEL WELDS GREATER THAN 2.5 INCHES IN THICKNESS

EFFECTIVITY AND APPROVAL

Page	Change	Date
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Prepared By: J K Fazzarelli Date: 2/12/90

Technical Review: Joel A. Godwin Date: 26FEB90

Approved By: David Frank Rosow Date: 2/26/90
Department Director

MANUAL ULTRASONIC EXAMINATION OF FERRITIC PRESSURE VESSEL WELDS GREATER THAN 2.5 INCHES IN THICKNESS

SAM2-UT15

1. PURPOSE AND APPLICATION

(1) This procedure provides the information and detailed steps necessary to ensure a complete and accurate manual ultrasonic examination of Class 1 and Class 2 ferritic pressure vessel welds and adjacent base material in accordance with the applicable American Society of Mechanical Engineering (ASME) Boiler and Pressure Vessel Codes.

(2) This procedure has been prepared for the manual, contact, pulse-echo, shear-wave angle-beam and longitudinal-wave straight-beam, ultrasonic examination of pressure vessel welds and adjacent base material.

(3) Class 1 and Class 2 ferritic pressure vessel welds and adjacent base material with 2.5 to 12.0 inches nominal wall thickness shall be examined. Welds to be examined shall be as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components."

(2) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Block

Reference blocks used for screen distance calibration and verification shall be of the same basic material as the production material, carbon steel, and shall be one of the following: (1) SwRI Half-Round, (2) AWS-type DC, (3) IIW, or (4) Rompas/V2 Block.

4.3 Basic Calibration Block

(1) Where the component material is clad, the basic calibration block shall be clad to the component clad nominal thickness ±1/8 inch. Deposition of clad shall be by the automatic method used on 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.

(2) Side-drilled basic calibration hole reflectors in accordance with Figure I-3131 of Section XI, Appendix I, of the ASME Boiler and Pressure Vessel Code shall be placed in a block manufactured from one of the following: (1) the component nozzle dropout; (2) the component prolongation; or (3) when it is not possible to fabricate the block from material taken from the component, it may be fabricated from a material of a specification included in the applicable examination volumes of the component. The basic calibration block thickness shall be determined by the average thickness of the weld. The requirements for basic calibration block curvature limits, heat treatment, surface condition, and scribe lines shall be in accordance with Appendix I.

(3) Notches 2%T deep shall be machined in the basic calibration block surface, in accordance with Appendix I of Section XI.

(4) A flat basic calibration block or block of essentially the same curvature as the examination contact surface shall be used for the examination of welds with a contact surface curvature greater than 20 inches in diameter.

(5) A single curved basic calibration block may 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.

(6) Approved drawings of the basic calibration blocks are contained in the applicable SwRI Examination Plan.

4.4 Search Units

Search units shall be selected from the following:

(1) Straight-Beam

Average Weld Thickness	Nominal Search Unit Size
2.5" to 3.0"	3/8" Round
2.5" to 4.0"	1/2" Round
3.0" to 7.0"	3/4" Round or 1" Round
5.0" to 12.0"	1" Round or 1-1/8" Round

(2) Angle-Beam

Average Weld Thickness	Nominal Search Unit Size
2.5" to 4.0"	1/2" x 1/2", 1/2" Round
2.5" to 7.0"	1/2" x 1", 3/4" Round
5.0" to 12.0"	1" x 1", 1" Round, 1-1/8" Round

Search unit wedges shall be fabricated to produce 45° ±2° and 60° ±2° refracted shear waves. A search until producing 0° straight-beam longitudinal waves shall also be used.

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 of the sound beam shall be marked on the search unit wedge.

The nominal search unit frequency shall be 2.25 MHz.

4.4 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 Couplant

(1) USP-grade glycerine or deionized water shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(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.

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

4.7 Thermometer

The thermometer to be used for measuring the calibration block and component temperatures shall be calibrated and certified and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

5. CALIBRATION METHOD

5.1 Instrument Linearity

(1) Ultrasonic instrument linearity shall be verified, as a minimum, within one day before and one day after performing all required ultrasonic examinations during a preservice examination, an outage, or every three months, whichever is less, in accordance with Paragraphs 5.1.1 and 5.1.2. Data required shall be recorded on the SwRI Instrument Linearity Verification Record and the sheet number shall be referenced on each applicable SwRI Sonic Instrument Calibration Record.

(2) If a linearity verification cannot be performed due to instrument failure, the calibration verification of Paragraph 5.2.8 shall constitute evidence of the instrument linearity. If a calibration verification does not fall within the tolerances required by Paragraph 5.2.8(2) due to instrument failure, an instrument linearity check must be performed prior to continuing examinations, and all components examined since the last valid calibration verification shall be reexamined.

> **NOTE**
>
> The damping control setting shall be in the same position during linearity verification, calibrations, and examinations, and shall be recorded on the applicable SwRI Instrument Linearity Verification Record. If the damping control has been changed, a new linearity verification shall be performed.

5.1.1 Screen Height Linearity

(1) Position a search unit on a basic calibration block and obtain indications from two applicable reflectors.

(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, set the larger indication to 100% of FSH and record the position of the smaller indication, estimated to the nearest 1% of FSH.

(4) 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.

5.1.2 Amplitude Control Linearity

(1) Position a shear-wave search unit on a basic calibration block to obtain a maximum amplitude from an applicable reflector.

NOTE

The primary reference level sensitivity should be within the highest and lowest gain settings used during amplitude control linearity verifications. The highest and lowest gain settings used during the amplitude control linearity verifications shall be recorded in the Remarks column of the applicable SwRI Sonic Instrument Linearity Verification Record.

(2) Without moving the search unit, set the indication to the required percent of FSH and increase or decrease the dB as specified below. The estimated signal shall be 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%	-12 dB	16 to 24%
40%	+ 6 dB	64 to 96%
20%	+12 dB	64 to 96%

*Minus denotes decrease in amplitude; plus denotes increase.

5.2 Calibration

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) The FREQ MHz control shall be turned to 2.

(4) The type and length of the search unit cable shall be recorded on the SwRI Sonic Instrument Calibration Record and all other information requested on the form shall be entered.

(5) The centerline of the search unit shall be at least 1-1/2 inches 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.

(6) When the examination is to be performed from the outside surface of a clad vessel, the calibration shall be accomplished from the unclad surface of the basic calibration block. When the examination is to be performed from the inside surface of a clad vessel, the calibration shall be accomplished from the clad surface of the basic calibration block.

5.2.1 Temperature Requirements

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

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

5.2.2 Straight-Beam

(1) Select shortest screen distance size that includes at least 1/4t beyond the nominal production material thickness.

(2) Position the search unit on the appropriate reference block, observe back reflections, and set up a linear sound path distance along the screen baseline.

5.2.3 Angle-Beam Distance Calibration

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

(2) Observing radius echoes from the applicable reference block, set up the required linear sound path distance along the screen baseline.

(3) When the same instrument is used for both 45° and 60° examinations, the screen distance calibration shall be conducted as follows:

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

(b) Position the 45° search unit on the appropriate reference block. Observe and record all verification block entries as required on the appropriate SwRI Sonic Instrument Calibration Record.

(c) Position the 60° search unit on the appropriate reference block. Without changing the calibrated screen distance, observe and record all verification block entries as required on the appropriate SwRI Sonic Instrument Calibration Record.

(d) No attempt shall be made to compensate for any delay difference observed between 45° and 60° screen distance calibrations. This difference shall be considered when resolving indications.

5.2.4 Straight-Beam Distance Amplitude Correction

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

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

(2) Set this response to the primary reference response of 80% ±5% of FSH and mark its amplitude on the screen.

(3) Without changing the gain controls, obtain maximum response from the remaining calibration holes; mark and join all amplitude points with a smooth curved line which shall extend 1/8 vee-path beyond the last qualified calibration point.

5.2.5 Angle-Beam Distance Amplitude Correction from the Clad Side or on Nonclad Blocks

(1) Position the 45° search unit on the basic calibration block to obtain maximum response from the calibration hole selected from the following, that produces the highest amplitude:

Hole	45° Vee-Path Positions
1/4T	1/8
1/2T	2/8
3/4T	3/8, 5/8

(2) Set this response to 80% ±5% of FSH and mark its amplitude on the screen. This is the primary reference level.

(3) Without changing the gain controls, obtain maximum response from the remaining vee-path positions; mark on screen, and join all amplitude points with a smooth, curved line.

(4) With the instrument gain set at the primary reference level, position the 45° search unit for maximum amplitude from the square notch on the opposite surface. Mark the signal amplitude with an X. The indication from the square notch must be considered when evaluating reflectors at the opposite surface.

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

5.2.6 Angle-Beam Distance Amplitude Correction from the Unclad Side of Clad Blocks

(1) Position the 45° search unit on the basic calibration block to obtain maximum response from the calibration hole selected from the following, that produces the highest amplitude.

Hole	Vee-Path Positions
1/4T	1/8
1/2T	2/8
3/4T	3/8

(2) Set this response to 80% ±5% of FSH and mark its amplitude on the screen.

(3) Without changing the gain controls, obtain maximum response from the other vee-path positions and mark on screen.

(4) Position the 45° search unit on the clad side of the block. Determine the dB difference between the 3/8 and 5/8 vee-path. Mark the location of the 5/8 vee-path on the baseline of the instrument.

(5) Position the 45° search unit on the unclad side of the block. Adjust the instrument gain controls to the primary reference level established in step (2) and obtain the maximum response from the 3/8 vee-path.

(6) Decrease the signal from the 3/8 vee-path by the dB difference determined in step (4). Mark the amplitude of this signal at the location of the 5/8 vee-path determined in step (4). Join the marks on the instrument screen to construct the DAC curve.

(7) With the instrument gain set at the primary reference level, obtain maximum amplitude from the square notch on the opposite surface. Mark the signal amplitude with an X. The indication from the square notch must be considered when evaluating reflectors at the opposite surface.

(8) Repeat steps (1) through (7) using a 60° search unit.

5.2.7 Beam Spread and Beam Angle Determination

Angle-beam search units used for examinations shall be measured for beam spread and beam angle after the initial calibration and prior to the examination, or with substitution of the basic calibration block, the search unit transducer or wedge, as follows:

(1) Calibrate the instrument on the basic calibration block as described in Paragraphs 5.2.3 and 5.2.5 or 5.2.6.

(2) With the instrument at the primary reference level sensitivity, position the search unit for maximum amplitude from the 1/4T hole (W_{max}). Measure and record the distance from the incident point of the search unit to the scribe line above the 1/4T hole.

(3) Repeat step (2) recording the distance to the scribe line for both the 1/2T and 3/4T maximum amplitudes.

(4) Increase the instrument gain 2 times the primary reference level sensitivity (6 dB) to the curve marked on the instrument screen represents the 50% DAC curve.

(5) Position the search unit for maximum amplitude from the 1/4T hole. Move the search unit toward the hole until the indication equals the 50% DAC line. Measure and record the distance from the incident point of the search unit to the scribe line above the 1/4T hole (W_1).

(6) Move the search unit away from the hole until the indication equals the 50% DAC line. Measure and record the distance from the incident point of the search unit to the 1/4T scribe line (W_2).

(7) Repeat steps (5) and (6), recording the measurements for the 1/2T and 3/4T holes.

(8) Plot these points on a 1:1 or 2:1 scale drawing of the basic calibration block thickness or on the graph on the back of the SwRI Beam Spread Record. When plotting Ws on a graph or scale drawing, place the points at the appropriate depth (1/4T, 1/2T, or 3/4T).

(9) Draw a separate line to each of the W max points from the incident point of the search unit.

(10) The angle to each of the points shall be measured using a protractor. The beam angle shall be established by determining the average of the three W max angles measured. This angle shall be recorded on the SwRI Beam Spread Record and considered during resolution of indications.

(11) Connect the three W_1 points extending the line to the search unit drawn at the top of the graph. Repeat this operation for the W_2 points. If the three W_1 or W_2 points do not form a straight line, then a line representing the

average of the three points shall be drawn and extended until they cross (the three points must be projected along the same beam path on the block drawing to complete this task).

(12) Measure the angle between the W_1 line and the W_2 line. This is the angle of beam spread.

5.2.8 <u>Sweep Range and DAC Curve Verification</u>

(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) Prior to 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 of batteries

(d) At least every 4 hours during the examination

(e) At the completion of a series of examinations

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

(2) Calibration Changes

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

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

(ii) Perform and record a new calibration

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

(b) Perform the following if any point on the DAC curve has moved on the sweep line more than 5% of the sweep division reading:

(i) Correct the sweep range and record the change on the SwRI Sonic Instrument Calibration Record.

(ii) If any indications have been recorded with this calibration, the swRI Examination Record shall be voided, a new calibration performed, and the areas for which examinations have been voided reexamined.

(3) Recalibration

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

(a) Search unit transducer or wedge

(b) Search unit cable type or length

(c) Ultrasonic instrument

(d) Examination personnel

(e) Couplant

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

5.2.9 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Surface Condition

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

6.2 Transfer

The transfer method shall not be used.

6.3 Scanning

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

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

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

(b) 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 any method which yields a signal response within ±2 dB of 80% FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

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

(4) The search unit movement rate shall not exceed 6 inches per second.

6.4 Reference Points for Physical Measurements

6.4.1 Nozzle-to-Shell Welds

A concentric reference circle around each nozzle which encompasses the scan area shall be marked on the shell and referenced to the centerline of the respective nozzle by indicating its radius. The location of the 0° azimuth of each nozzle shall be noted on the appropriate SwRI Examination Record. The location of the 0°, 90°, 180°, and 270° azimuths shall be marked on the shell along the concentric reference circle in a clockwise direction as viewed from the vessel exterior. Each 30 degrees of azimuth for nozzle welds with a radius greater than 4 inches, each 15 degrees of azimuth for nozzle welds greater than 12 inches, and each 5 degrees of azimuth for nozzles greater than 24 inches shall be marked along the reference circle. A concentric reference circle shall also be marked within 1/2 inch of the weld centerline. Every 10 inches around this inner circle shall be marked on the vessel and utilized for measurements. Radial lines should be drawn through each of these azimuth points.

6.4.2 Longitudinal Butt Welds

A reference line shall be drawn along the centerline of each longitudinal butt weld. Distance along this reference line shall be measured in inches and common fractions from the junction of the intersecting circumferential weld and entered on the applicable SwRI Examination Record.

6.4.3 Circumferential Butt Welds

A reference line shall be drawn along the centerline of each circumferential weld. The 0° point shall coincide with the vessel 0° point. Distance along this reference line shall be measured clockwise in inches and common fractions, as viewed from above for vertical vessels or as viewed from an identified end of horizontal vessels. This distance shall be entered on the applicable SwRI Examination Record.

6.4.4 Spherical Vessel Head Circumferential and Meridional Welds

A detailed scale drawing shall be obtained to determine the exact weld configuration. In cases where the weld crown is on the inside surface and the examination is to be performed from the outside surface, the examiner shall determine the examination area based upon the weld configuration on the inside surface.

6.5 Examination Areas

(1) Longitudinal and circumferential butt welds and nozzle-to-vessel butt welds in ferritic pressure vessels with 2.5 to 12.0 inches nominal thickness shall be examined.

(2) Manual ultrasonic examination of pressure vessel welds and adjacent base material shall be performed from the inside or outside surface of the vessel.

(3) Examination area shall be the weld and adjacent base material for a distance of 1/2t for Class 1 and 1t for Class 2 from the fusion line on each side of the weld for longitudinal and circumferential butt welds, and the weld and 1/2t for Class 1 and 1t for Class 2 of base material on the vessel side of the weld for nozzle-to-vessel butt welds. In cases where the weld crown is on the inside surface, the distance shall be based upon the fusion line of the weld crown as shown on detail drawings.

6.5.1 Base Material Lamination Scan

(1) Before the angle-beam examination, a lamination scan using straight-beam longitudinal wave shall be performed covering the entire area through which the angle beam is to be passed. Screen distance calibration for this examination shall be conducted in accordance with Paragraph 5.2.2. The first back reflection shall be maintained at an amplitude between 50% and 90% of FSH.

(2) Laminar indications shall be recorded as follows:

Obtain a back reflection signal from an indication-free area and adjust this signal to 80% ±5% of FSH. Record the intermediate indication when its amplitude is equal to the remaining back reflection. Areas of total loss of back reflection accompanying the intermediate echo shall also be recorded.

6.5.2 Thickness Measurements

Thickness measurements shall be taken on the centerline of the weld and at one point in the base material on each side of the weld for circumferential and longitudinal welds, and at one point in the base material on the vessel side adjacent to the weld for nozzle-to-vessel welds. Screen distance calibration for these examinations shall be conducted in accordance with Paragraph 5.2.2. Measurements shall be taken by placing the straight-beam search unit on the examination surface and noting the backwall reflection on the instrument screen. These measurements shall be recorded on the appropriate SwRI Examination Record.

6.5.3 Angle-Beam Examination for Indications Parallel with the Weld

Angle-beam examinations shall be accompanied using 45° and 60° refracted shear waves from both sides of the weld for circumferential and longitudinal welds, and from the vessel side of the weld for nozzle-to-vessel welds. This examination shall be performed by directing the sound beam perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 5.2.3 and 5.2.5 or 5.2.6.

6.5.4 Straight-Beam Examination of Welds

A straight-beam examination shall be applied, when possible, to the surface of the weld crown and 1t of base material on each side of the weld for circumferential and longitudinal welds and, when possible, to the surface of the weld crown and 1t of base material on the vessel side of the weld for nozzle-to-vessel welds. Calibration for the straight-beam examination shall be in accordance with Paragraphs 5.2.2 and 5.2.4.

6.5.5 Angle-Beam Examination for Indications Perpendicular to the Weld

Angle-beam examination shall be conducted using a 45° and 60° shear-wave search unit. 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 length of the weld and 1t of base material on each side of the weld for circumferential and longitudinal welds, and 1t of base material on the vessel side of the weld for nozzle-to-vessel welds shall be scanned with the search unit sound beam directed in this manner from two opposing directions. Calibration for these examinations shall be in accordance with Paragraphs 5.2.3 and 5.2.5 or 5.2.6.

6.6 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded utilizing the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) Ultrasonic reflectors producing a response 50% or greater of the reference level and planar surface reflectors equal to or exceeding the response from the square notch shall be recorded on the appropriate SwRI Examination Record.

(3) Indications producing a response 50% or greater of the reference level and planar surface reflectors equal to or exceeding the response from the square notch shall be investigated by a Level II or Level III examiner to determine the shape, identity, and location of the reflector.

(4) Indications 50% or greater of the reference level and planar surface reflectors equal to or exceeding the response form the square notch investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

(5) When an examination is performed from the unclad side of a clad vessel and the calibration is as specified in Paragraph 5.2.5, indications observed past the 4/8 vee-path shall not be recorded.

(6) Scanning limitations shall be recorded.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with Article IWA-3000, Section XI, of the applicable ASME Boiler and Pressure Vessel Code.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI NDTR Form No.	Revision Date
17-17	07-15-79
17-18	07-31-75
17-19	12-01-83
17-25	03-14-79
17-36	08-03-82
17-37	02-18-80

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Title
MANUAL ULTRASONIC EXAMINATION OF PRESSURE-RETAINING STUDS AND BOLTS 2 INCHES OR GREATER IN DIAMETER CONTAINING ACCESS HOLES

EFFECTIVITY AND APPROVAL

Page	Change	Date
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Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: John R. Ianuzzi Date: 2/12/90

Technical Review: [signature] Date: 19 FEB 90

Approved By: David Frank Rosow Date: 2/21/90
Department Director

SwRI Form QA-3A-0

MANUAL ULTRASONIC EXAMINATION OF PRESSURE-RETAINING STUDS AND BOLTS 2 INCHES OR GREATER IN DIAMETER CONTAINING ACCESS HOLES

SAM2-UT18

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure a proper ultrasonic examination of pressure-retaining studs and bolts, in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) Pressure-retaining studs and bolts 2 inches or greater in diameter with access holes shall be examined as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

(3) A shear-wave angle-beam, manual, contact, pulse-echo ultrasonic examination technique utilizing the SwRI Manual Stud Examination Probe shall be used to detect flaws oriented perpendicularly to the axis of the stud.

(4) A high-angle longitudinal wave, manual, contact, pulse-echo ultrasonic examination technique utilizing the SwRI Manual Stud Longitudinal Examination Probe shall be used to detect inner surface flaws oriented perpendicularly to the axis of the stud.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) Code Case N-307-1

(4) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101 "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Blocks

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

(2) Reference blocks shall be used as follows for the angle-beam screen distance calibration:

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

4.3 Basic Calibration Blocks

(1) The basic calibration block shall be fabricated from material of the same nominal composition as the component to be examined. It shall be threaded as the component and shall have an access hole equal in size to that of the component to be examined.

(2) The basic calibration reflector for shear-wave angle-beam examination shall be a notch machined one thread deep or 1/8-inch deep, whichever is smaller. The notch shall be measured from the base of the thread root and shall follow the lead angle of the threads. The particular notch utilized for the calibration shall be identified on the SwRI Sonic Instrument Calibration Record.

(3) For bore inner surface examinations, the basic calibration reflector shall be a notch machined one thread deep, or 1/8-inch deep, whichever is smaller. The notch shall be placed on the inside surface of the access hole. The particular notch utilized for the calibration shall be identified on the SwRI Sonic Instrument Calibration Record.

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

4.4 Search Units

(1) The search unit size shall be 1/4 x 1/4 inch or 1/4 inch round.

(2) For shear-wave angle-beam examinations, a special search unit wedge that produces a 60° ±2° refracted shear-wave shall be used. This angle and the exit point of the sound beam shall be determined on an IIW block.

(3) For bore inner surface examinations, a special search unit wedge shall be used to produce a high angle longitudinal wave. The nominal search unit angle is 88°. The exit point shall be the scribe line made on the wedge during fabrication. If the exit point is not marked or is undiscernible, it shall be determined. The signal from the end of a calibration block or a near surface notch shall be maximized. The exit point will be at the near side of the notch on the edge of the calibration block.

(4) The nominal search unit frequency shall be 2.25 MHz.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 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. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(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.

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

5. CALIBRATION

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) The FREQ MHz control shall be turned to 2.

(4) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

(5) Calibration of the ultrasonic instrument shall be accomplished with the basic calibration block in a vertical position.

5.1 Shear-Wave Angle Beam

5.1.1 Distance Calibration

Using the applicable reference block selected in accordance with Subsection 4.2, set up the required sound path distance linearly along the instrument screen baseline. The screen distance chosen shall be the smallest applicable size that includes at least 10% of the screen distance past the examination area.

5.1.2 Distance Amplitude Correction

(1) Position the SwRI Manual Stud Examination Probe in the access hole of the basic calibration block to obtain maximum response from the notch reflector nearest the center of the threaded portion of the block.

(2) Set this signal to 75% ±5% of full screen height (FSH) and mark its amplitude on the instrument screen. This is the primary reference response. The gain controls shall not be adjusted once this primary reference response has been established.

(3) A line shall be drawn on the instrument screen at a distance of at least 0.5 inch prior to the calibration point.

5.2 Longitudinal Wave Angle Beam

5.2.1 Distance Calibration

Using the basic calibration block, set up the required sound path distance along the screen baseline. The screen distance shall be sufficiently long to position the initial pulse at 0 screen division and the notch indication at 5 divisions on the screen baseline.

5.2.2 Distance Amplitude Correction

(1) Position the SwRI Manual Stud Longitudinal Examination Probe in the access hole of the basic calibration block to obtain maximum response from the notch reflector on the inside surface of the access hole.

(2) Set this signal to 75% ±5% of FSH and mark this amplitude on the screen. This is the primary reference response. The gain controls shall not be adjusted once this primary reference response has been established.

(3) A line shall be drawn on the instrument screen at the primary reference amplitude extending from screen division 4 to screen division 6.

5.2.3 Sweep Range and Distance Amplitude Calibration Verification

(1) Sweep range and distance amplitude calibrations shall be verified on the appropriate reference and basic calibration block when any of the following occurs:

(a) Prior to a series of examinations

(b) With any substitution of the search unit cable

(c) With any substitution utilizing the same type of power source; e.g., a change of batteries

(d) At least every 4 hours during the examination

(e) At the completion of a series of examinations

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

(2) Calibration Changes

(a) Perform the following if the response from the notch decreases more than 20% or 2 dB in amplitude, or moves on the sweep line more than 5% of full screen width:

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

(ii) Conduct a new calibration.

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

(b) Perform the following if the response from the notch has increased in amplitude more than 20% or 2 dB:

(i) Correct the calibration.

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

(iii) Enter proper values on a new SwRI Ultrasonic Examination Record for Bolting.

(3) Recalibration

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

(a) Search unit transducer

(b) Ultrasonic instrument

(c) Examination personnel

(d) Couplant

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

(4) Verification of Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination of Pressure-Retaining Studs and Bolts

Forged studs and bolts shall be examined from the inside surface of the access hole. The examination area shall include the thread root and 1/4 inch as measured inward from the thread root (with the exception of the nonload-bearing portion beyond the nut) and the inside surface of the access hole. The outer 1/4 inch of the nonthreaded portion shall also be examined. Calibration shall be in accordance with Subsections 5.1 and 5.2.

6.2 Surface Conditions

The contact surfaces must be free of roughness or other conditions which interfere with free movement of the search unit or impair the transmission of ultrasound.

6.3 Scanning

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

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

(a) With the instrument at the primary reference level, manipulate the stud probe in the basic stud calibration block access hole to obtain a signal of 40% of FSH from a calibration reflector (machined notch).

(b) Add 6 dB 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 any method that yields a signal response within ±2 dB of 80% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

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

(4) The search unit movement rate shall not exceed 6 inches per second.

6.4 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) Ultrasonic reflectors producing a response 50% or greater of the reference level shall be recorded on the SwRI Ultrasonic Examination Record for Bolting.

(3) Recorded indications shall be investigated and resolved on the appropriate SwRI Indication Resolution Record by a Level II or Level III examiner to determine the shape, identity, and location of the reflector (i.e., plot, profile, review of radiographs, etc.)

(4) Indications 100% or greater of the reference level investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

(5) The end points of the indication as determined by 100% of the reference level shall be recorded.

(6) Scanning limitations shall be recorded.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with Article IWA-3000, Section XI, or the applicable ASME Boiler and Pressure Vessel Code.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI-NDTR Form No.	Revision Date
17-19	12-31-83
17-27	04-05-76

Title

MANUAL ULTRASONIC EXAMINATION OF THIN-WALL VESSEL WELDS (0.1 TO 0.4 INCH IN THICKNESS)

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-12	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: John R. Tizanelli Date: 2/6/90

Technical Review: Joel A. Godwin Date: 26 FEB 90

Approved By: David Frank Rosow Date: 2/26/90
Department Director

MANUAL ULTRASONIC EXAMINATION OF THIN-WALL VESSEL WELDS (0.1 TO 0.4 INCH IN THICKNESS)

SAM2-UT26

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps necessary to ensure a complete and accurate manual ultrasonic examination of thin-wall ferritic and austenitic pressure vessel welds and adjacent base material, in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) Pressure vessel welds in the thickness range from 0.1 to 0.4 inch, adjacent base material, heat-affected zone, vessel support attachments, and nozzle-to-shell welds shall be examined as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

(3) Manual, contact, pulse-echo shear-wave angle-beam and longitudinal-wave straight-beam ultrasonic techniques shall be utilized in accordance with this procedure.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1974 Edition with Addenda through Summer 1975, "Welding and Brazing Qualifications"

(4) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 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.

4.3 Basic Calibration Block

(1) The basic calibration block shall be fabricated from material of the same or equivalent P-number grouping as the production material, as specified in Section IX of the ASME Code. P-numbers P-1, P-3, P-4, and P-5 shall be considered equivalent for the purpose of this examination.

(2) Calibration reflectors shall be notches machined on the outside and inside surfaces of the basic calibration block. The notches shall be in accordance with approved drawings of the basic calibration block contained in the applicable SwRI Examination Plan.

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

(4) A single curved basic calibration block may be used to establish sensitivity calibration for the examination of welds in the curvature range from 0.9 to 1.5 times the basic calibration block diameter, when the contact surface curvature is 20 inches in diameter or less.

(5) On contact surface curvatures greater than 20 inches in diameter, a flat basic calibration block or block of essentially the same curvature as the examination contact surface may be used to establish sensitivity calibration.

4.4 Search Units

Search units shall be selected from the following:

(1) Straight-Beam (Longitudinal-Wave)

(a) The search unit shall be either a 1/4" Aerotech (Diamond) Gamma MSWS or a 1/4" Round Dual Element.

(b) A 1/4" round longitudinal-wave dual-element search unit shall be used at a frequency of 2.25 MHz or 5.0 MHz. A 1/4" Aerotech (Diamond) Gamma MSWS search unit shall be used only at a frequency of 5.0 MHz.

(c) A delay line shoe shall be attached if a 1/4" Aerotech (Diamond) Gamma MSWS search unit is used.

(2) Angle-Beam (Shear-Wave)

(a)

Nominal Production Material Thickness	Nominal Search Unit Size
0.1" to 0.4"	1/4" x 1/4", 1/4" Round
0.2" to 0.4"	3/8" x 3/8", 3/8" Round

(b) Search unit wedges shall be fabricated as required to produce a 45° ±2° refracted shear wave. Other angles may be used to supplement the examination.

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

(d) The nominal shear-wave search unit frequency for carbon steel shall be 2.25 MHz.

(e) The nominal shear-wave search unit frequency for examination of austenitic material shall be as follows:

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

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 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. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(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.

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

5. CALIBRATION METHOD

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) The FREQ MHz control shall be turned to 1 when a 1.5-MHz search unit is used, to 2 with a 2.5-MHz search unit, and to 5 with a 5.0-MHz search unit.

(4) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

5.1 Straight-Beam Distance Calibration

(1) The screen distance chosen shall be the shortest applicable size to include at least 1/4t beyond the nominal production material.

(2) Attach a delay line shoe if a 1/4" Aerotech (Diamond) Gamma MSWS search unit is used.

(3) Position the search unit on an appropriate reference block, observe the back reflections, and set up a linear sound path distance along the instrument screen baseline.

5.2 Angle-Beam Distance Calibration

(1) Select the shortest screen distance size that includes at least 1/8 vee path beyond the anticipated examination range.

(2) Position the shear-wave search unit on an appropriate reference block, observe the radius echoes, and set up a linear sound path distance along the screen baseline.

5.3 Straight-Beam Distance Amplitude Correction (DAC)

A DAC curve shall not be constructed with this procedure.

5.4 Angle-Beam Distance Amplitude Correction

NOTE

When examining circumferential welds utilizing a curved block, DAC curves shall be constructed from notches perpendicular to the axis of the basic calibration block. DAC curves shall be constructed from the axial notches for the remaining examinations utilizing curved basic calibration blocks.

(1) Position the angle-beam search unit on the basic calibration block to obtain maximum response from the vee-path position selected from the following, which produces the highest amplitude:

Vee-Path Positions

4/8, 8/8, 12/8

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

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line which shall not extend more than 1/8 vee path beyond the last qualified calibration point.

EXCEPTION

If the configuration of the weld is such that the full vee-path examination fails to cover the entire weld volume, a 16/8 vee-path calibration shall be accomplished.

5.5 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 20% of FSH or greater, adjacent to a DAC point that falls below 20% of FSH, shall be brought to the primary reference level and marked on the instrument screen. The adjacent point(s), previously at less than 20% of FSH, 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.

EXCEPTION

When the first DAC point is the only point above 20% of FSH, the next highest point shall be brought to the primary reference level and marked on the instrument screen. The other points previously at less than 20% of FSH shall be marked on the screen and all points connected with a smooth curved line.

5.6 Calibration Verification

5.6.1 Sweep Range and DAC Curve Verification

Sweep range and DAC curve calibration shall be verified on the appropriate reference and basic calibration block when any of the following occur:

(1) Prior to a series of examinations

(2) With any substitution of the search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.6.2 Calibration Changes

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

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

(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% 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.

5.6.3 Recalibration

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

(1) Search unit wedge or transducer

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

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

5.6.4 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signals from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination Areas

(1) Ultrasonic examination of pressure vessel welds and adjacent vessel base material 0.1- to 0.4-inch nominal thickness shall be performed from the outside surface of the vessel.

(2) Base material adjacent to welds shall be examined for a minimum distance of 1.0 inch from the fusion line on each side of the weld on longitudinal and circumferential butt welds and for a minimum distance of 1.0 inch from the fusion line on the vessel side of the weld for nozzle-to-shell and support attachment welds.

6.2 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.

6.3 Transfer

No attempt shall be made to determine differences in the acoustic properties between the basic calibration block and the production material, which would result in an instrument gain change.

6.4 Scanning

(1) When practical, scanning shall be performed at a minimum gain setting 5 times the reference level sensitivity.

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

(a) With the instrument at the primary reference level, manipulate the search unit on the basic calibration block to obtain a signal of 20% of FSH from a calibration reflector (notch).

(b) Add 14 dB of gain by utilizing the 14 dB switch (if present), the fine gain control, or a combination of the fine and coarse gain controls and choose any method which yields a signal response within 2 dB of 100% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 5 times the reference level sensitivity.

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

(4) The search unit movement rate shall not exceed 6 inches per second.

6.5 Base Material Lamination Scan

Prior to the shear-wave examination, a longitudinal-wave lamination scan shall be performed which shall cover the entire area through which the angle beam is to be passed. This examination shall be conducted as follows:

(1) The screen distance calibration shall be conducted in accordance with Subsection 5.1.

(2) Scanning sensitivity shall be as required to maintain back reflection at an amplitude of between 50% and 90% of FSH.

(3) To record an intermediate indication, a back reflection signal shall be obtained from an indication-free area and set at an amplitude of 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. Areas of total loss of back reflection accompanying the intermediate echo shall also be recorded.

6.6 Thickness Measurements

Thickness measurements shall be taken at a minimum of three points on longitudinal and circumferential butt welds (on the centerline of the weld and at one point in the base material on each side of the weld) and at a minimum of two points on nozzle-to-shell and support attachment welds (one point on the vessel side of the weld and one on the nozzle or support attachment side of the weld). Screen distance calibration for this examination shall be conducted in accordance with Subsection 5.1. Measurements shall be taken by placing the 0° search unit on the examination surface and recording the position of the backwall reflection observed on the instrument screen.

6.7 Longitudinal and Circumferential Butt Welds in Vessels

6.7.1 Angle-Beam Examination for Indications Parallel with the Weld

(1) Angle-beam examination for indications parallel with the weld shall be accomplished using a 45° refracted shear wave from both sides of the weld. Calibration for these examinations shall be in accordance with Subsections 5.2 and 5.4. Other angles may be used as referenced in Subsection 4.4.

(2) When an examination cannot be accomplished from both sides of the weld, a 45° refracted shear-wave examination shall be accomplished from one side of the weld.

6.7.2 Angle-Beam Examination for Indications Perpendicular to the Weld

An angle-beam examination shall be conducted on the weld and the base material on both sides of the weld using the 45° shear-wave unit. This examination shall be conducted by placing the search unit on the surface of the weld and base material with the sound beam directed in an axial orientation with respect to the weld to detect indications perpendicular to the weld. The entire length of the weld and the adjacent base material shall be scanned with the search unit directed in this manner. The search unit shall then be turned 180° and the scan repeated. Scanning coverage for this examination shall extend a minimum of 1 inch from the weld fusion line. Calibration for this examination shall be in accordance with Subsections 5.2 and 5.4.

6.8 Butt and Fillet Welds of Support Attachments and Nozzle-to-Shell Welds

6.8.1 Angle-Beam Examination for Indications Parallel with the Weld

Angle-beam examination for indications parallel with the weld shall be accomplished using a 45° refracted shear wave from the vessel side of the weld. The sound beam shall be directed perpendicularly into the weld for this examination. Calibration for these examinations shall be in accordance with Subsections 5.2 and 5.4. Other angles may be used as referenced in Subsection 4.4.

6.8.2 Angle-Beam Examination for Indications Perpendicular to the Weld

An angle-beam examination shall be conducted on the weld and on the base material on the vessel side using the 45° shear-wave unit. This examination shall be conducted by placing the search unit on the surface of the weld and base material with the sound beam directed in an axial orientation with respect to the weld to detect indications perpendicular to the weld. The entire length of the weld and the adjacent base material shall be scanned with the search unit directed in this manner. The search unit shall then be turned 180° and the scan repeated. Scanning coverage for this examination shall extend a minimum of 1 inch from the weld fusion line. Calibration for this examination shall be in accordance with Subsections 5.2 and 5.4.

6.9 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) Indications producing a response 20% or greater of the reference level shall be recorded and investigated by a Level II or a Level III examiner to determine the shape, identity, and location of the reflector.

(3) Indications 20% or greater of the reference level attributable to geometry shall be recorded only once, even if the amplitude of the indication drops below the required recording amplitude along its length. These indications shall be investigated by a Level II or a Level III examiner to determine the shape, identity, and location of the reflector.

(4) If indications which have been recorded as geometry have been investigated and found to be nongeometric reflectors, the entire weld shall be reexamined, recording all nongeometric reflectors and other reflectors not previously recorded at least once.

(5) 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 a Level III examiner to determine the shape, identity, and location of the reflector. Examples of nongeometric reflectors 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.

(6) Indications investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with Article IWA-3000, Section XI, or the applicable ASME Boiler and Pressure Vessel Code.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI-NDTR Form No.	Revision Date
17-18	7/31/75
17-19	12/1/83
17-25	3/14/79
17-110	3/3/82

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Title

MANUAL ULTRASONIC EXAMINATION OF THIN-WALL PIPING WELDS

EFFECTIVITY AND APPROVAL

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Department Director

SwRI Form QA-3A-0

MANUAL ULTRASONIC EXAMINATION OF THIN-WALL PIPING WELDS

SAM2-UT32

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps necessary to ensure a complete and accurate manual ultrasonic examination of welds and adjacent base material of Class 1 and Class 2 thin-wall piping in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) Angle-beam shear-wave, straight-beam longitudinal-wave, manual, contact, pulse-echo ultrasonic techniques shall be employed for thin-wall piping weld examinations. Thin-wall piping welds and adjacent base material in a 0.1- to 0.4-inch nominal thickness range shall be examined as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) ASME Boiler and Pressure Vessel Code, Section IX, 1974 Edition with Addenda through Summer 1975, "Welding and Brazing Qualifications"

(4) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations in accordance with this procedure shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Block

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

4.3 Basic Calibration Block

(1) The basic calibration block shall be fabricated from material of the same or equivalent P-number grouping as the production material, as specified in Section IX of the ASME Code. P-numbers P-1, P-3, P-4, and P-5 shall be considered equivalent for the purpose of this examination.

(2) Calibration reflectors shall be notches machined on the outside and inside surfaces of the basic calibration block. The notches shall be in accordance with approved drawings of the basic calibration block contained in the applicable SwRI Examination Plan.

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

(4) A single curved basic calibration block may be used to establish distance amplitude correction (DAC) curves for the examination of welds in the curvature range from 0.9 to 1.5 times the basic calibration block diameter when contact surface curvature is 20 inches or less in diameter.

(5) Contact surface curvatures greater than 20 inches in diameter may use a flat basic calibration block or block of essentially the same curvature as the examination contact surface to establish DAC curves.

4.4 Search Units

Search units shall be selected from the following:

(1) Straight-Beam

(a) The search unit size shall be a 1/4" x 1/4" Aerotech (Diamond) Gamma MSWS or a 1/4" Round Dual Element.

(b) A 1/4" round longitudinal-wave dual-element search unit shall be used at a frequency of 2.25 MHz or 5.0 MHz. An Aerotech (Diamond) 1/4" x 1/4" Gamma MSWS search unit shall be used only at a frequency of 5.0 MHz.

(2) Angle-Beam

(a) Nominal Production Material Thickness / Search Unit Size

Nominal Production Material Thickness	Search Unit Size
0.1" to 0.4"	1/4" x 1/4", 1/4" Round
0.2" to 0.4"	3/8" x 3/8", 3/8" Round

(b) 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" Round, 1/4" x 1/4"
1.5 MHz	3/8" Round, 3/8" x 3/8"

(c) The nominal shear-wave search unit frequency for carbon steel piping shall be 2.25 MHz.

(d) Search unit wedges shall be fabricated as required to produce a 45° ±2° refracted shear wave. Other angles may be used to supplement the examination.

(e) 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.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 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. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(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.

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

5. CALIBRATION METHOD

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) The nominal piping production material thickness shall be used to determine the correct basic calibration block and search units for examinations with geometric restrictions such as piping or components which may be thicker than the nominal pipe size, examinations limited to one side of the weld, or wide weld crowns. The Level II or Level III examiner shall ensure that complete coverage of the examination area is obtained. Additional calibration vee-path positions and larger screen sizes, which may be required to assure this coverage, shall be used for the examination from either side of the weld.

(4) 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.

(5) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

5.1 Straight-Beam Distance Calibration

(1) 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.

(2) Attach a delay line shoe if a 1/4" x 1/4" Aerotech (Diamond) Gamma MSWS search unit is used.

(3) Observing the back reflections from the applicable reference block, set up the required linear sound path distance along the instrument screen baseline.

5.2 Angle-Beam Distance Calibration

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

(2) Observing radius echoes from the applicable reference block, set up the required linear sound path distance along the screen baseline.

5.3 Angle-Beam DAC

DAC curves shall be constructed from notches perpendicular to the axis of the basic calibration block when examining circumferential welds utilizing a curved block. DAC curves shall be constructed from the axial notches for examinations of longitudinal welds, support attachments, and branch connections when a curved basic calibration block is utilized. The DAC curve shall be constructed as follows:

(1) Position the angle-beam search unit on the basic calibration block to obtain maximum response from the vee-path position, selected from the following, which produces the highest amplitude:

<u>Vee-Path Positions</u>

4/8, 8/8, 12/8

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

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall extend 1/8 vee-path beyond the last qualified calibration point.

5.4 Secondary DAC Calibrations

Each point on the DAC curve shall appear at a minimum of 20% of FSH or a secondary DAC curve shall be constructed as follows:

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

(2) The DAC point at the 8/8 vee-path positions shall be brought to the primary reference level and marked on the instrument screen. The 12/8 vee-path position, previously at less than 20% of FSH, shall be marked on the screen and both points connected with a smooth curved line. Instrument gain settings for this secondary DAC curve shall be recorded on the appropriate SwRI Sonic Instrument Calibration Record.

EXCEPTION

When the 8/8 vee-path position is set at the primary reference level and the 12/8 vee-path position is below 20% of FSH, a secondary DAC curve is not required.

5.5 Calibration Verification

5.5.1 Sweep Range and DAC Curve Verification

Sweep range and distance amplitude calibration shall be verified on the appropriate reference and basic calibration block when any of the following occurs:

(1) Prior to a series of examinations

(2) Substitution of search unit cable

(3) With a substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.5.2 <u>Calibration Changes</u>

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

(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% 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.

5.5.3 <u>Recalibration</u>

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

(1) Search unit transducer or wedge

(2) Ultrasonic instrument

(3) Examination personnel

(4) Couplant

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

5.5.4 Verification of Calibration Reflectors at Scanning Speeds

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signals from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination Areas

6.1.1 Longitudinal and Circumferential Butt Welds in Piping

(1) Longitudinal and circumferential piping welds and adjacent base material with a 0.1- to 0.4-inch nominal thickness shall be examined from the outside surface.

(2) Base material adjacent to welds shall be examined for a minimum distance of 1.0 inch from the fusion line on each side of the weld.

(3) Class 1 longitudinal welds shall be examined along the entire length of the weld during the preservice examination, and for 12 inches from the fusion line of the intersecting circumferential weld during inservice examinations. Class 2 longitudinal welds shall be examined along the entire length of the weld during the preservice and inservice examinations.

6.1.2 Butt and Fillet Welds of Support Attachments and Branch Connections

(1) Butt and fillet welds of support attachments and branch connections in pressure piping with a 0.1- to 0.4-inch nominal thickness shall be examined from the outside surface of the main run pipe.

(2) Base material of the main run pipe shall be examined for a minimum distance of 1.0 inch from the weld fusion line.

6.2 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.

6.3 Indication Length Zero Reference (L_0) Location

Areas to be examined in accordance with this procedure shall have an L_0 marked in accordance with the applicable revision of SwRI NPOP SwRI-NDE7.

6.4 Scanning Parameters

(1) When practical, scanning shall be performed at a minimum gain setting 5 times the reference level sensitivity.

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

(a) 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 (notch) of 20% of FSH.

(b) Add 14 dB of gain using the 14 dB switch (if present), the fine gain, or a combination of the fine and coarse gain controls, and choose the method which yields a signal response within ±2 dB of 100% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 5 times the reference level sensitivity.

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

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

6.5 Attenuation, Lamination Scan, and Thickness Measurements

6.5.1 Attenuation

No attempt shall be made to determine differences in the acoustic properties between the basic calibration block and the production material which would result in an instrument gain change.

6.5.2 Base Material Lamination Scan

(1) A lamination scan using straight-beam longitudinal wave and covering the entire area through which the angle beam is to be passed shall be performed before the angle-beam examination. Scanning sensitivity of the

first back reflection shall be maintained at an amplitude of between 50% and 90% of FSH.

> **NOTE**
>
> Screen distance calibration for lamination scans and thickness measurements shall be conducted in accordance with Subsection 5.1.

(2) To record an intermediate indication, a back reflection signal shall be obtained form an indication-free area and set 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. Areas of total loss of back reflection accompanying the intermediate echo shall also be recorded.

6.5.3 Thickness Measurements

Thickness measurements shall be taken at a minimum of three points adjacent to L_0 for longitudinal and circumferential welds (one on the centerline of the weld and one in the base material on each side of the weld) and at a minimum of two points adjacent to L_0 for support attachment and branch connection welds (one on the base material of the main run pipe and one on the branch connection or support attachment). Locations of measurements that cannot be taken adjacent to L_0 shall also be recorded. Measurements shall be taken by observing the position of the backwall reflection on the instrument screen.

6.6 Angle-Beam Examinations

> **NOTE**
>
> Calibration for angle-beam examinations shall be in accordance with Subsections 5.2, 5.3, and 5.4.

6.6.1 Angle-Beam Examination for Indications Parallel with the Weld

An angle-beam examination shall be accomplished using a 45° refracted shear wave from both sides of the weld for circumferential and longitudinal welds and from the main run pipe side of the weld for support attachments and branch connections. The sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. The entire weld and base material for a distance of 1 inch from each side of the weld fusion line for circumferential and longitudinal welds and 1 inch of base material of the main run pipe for support attachments and branch connections shall be examined. Other angles may be used as referenced in Subsection 4.4.

6.6.2 Angle-Beam Examination for Indications Perpendicular to the Weld

An angle-beam examination shall be conducted on the weld and adjacent base material using a 45° shear-wave search unit. This examination shall be conducted by placing the search unit on the weld and base material with the sound beam directed into the weld and base material parallel to the weld to detect indications perpendicular to the weld. The entire length of the weld and base material for a distance of 1 inch from each side of the fusion line for circumferential and longitudinal welds or 1 inch of base material on the main run pipe for support attachments and branch connections shall be scanned with the search unit directed in this manner. The search unit shall then be turned 180° and the scan repeated.

6.7 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable of SwRI NPOP SwRI-NDE3, except for the recording levels which shall conform to the following paragraphs of this section.

(2) Ultrasonic reflectors producing a response 20% or greater of the reference level shall be recorded. Ultrasonic reflectors (regardless of signal amplitude), not readily attributable to geometry by the examiner, shall be recorded on the appropriate SwRI Ultrasonic Examination Record.

(3) Indications 20% or greater of the reference level attributable to geometry shall be recorded only once, even if the amplitude of the indication fluctuates above and below the required recording amplitude along its length.

(4) Scanning limitations shall be recorded.

(5) Recorded indications shall be investigated and resolved on the appropriate SwRI Indication Resolution Record by a Level II or Level III examiner to determine the shape, identity, and location of the reflector (i.e., plot, profiles, review of radiographs, etc.).

(6) Indications investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with Article IWA-3000, Section XI, or the applicable ASME Boiler and Pressure Vessel Code.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI-NDTR Form No.	Revision Date
17-18	7-31-75
17-19	12-1-83
17-25	3-14-79
17-31	3-14-79
17-71	12-28-78
17-72	12-28-78

Title

MANUAL ULTRASONIC EXAMINATION OF STUDS AND BOLTS GREATER THAN ONE INCH TO LESS THAN THREE INCHES IN DIAMETER

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-8	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Jimmie Fanelli Date: 2/6/90

Technical Review: Jack A. Godin Date: 23FEB90

Approved By: David Frank Rosow Date: 2/23/90
Department Director

MANUAL ULTRASONIC EXAMINATION OF STUDS AND BOLTS GREATER THAN ONE INCH TO LESS THAN THREE INCHES IN DIAMETER

SAM2-UT36

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps necessary to ensure a complete and accurate manual ultrasonic examination of pressure-retaining studs and bolts in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

(2) Studs and bolts greater than 1 inch to less than 3 inches in diameter, 4 to 16 inches in length, shall be examined as required in the applicable Southwest Research Institute (SwRI) Examination Plan.

(3) Studs and bolts of the specified size shall be examined ultrasonically using longitudinal-wave straight-beam, manual, contact, pulse-echo techniques in accordance with this procedure.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel conducting ultrasonic examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101 "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Blocks

Reference blocks used for screen distance calibration and verification shall be made of carbon steel and shall be one of the following: (1) SwRI Half-Round, (2) AWS-type DC, (3) IIW, or (4) RSR.

4.3 Basic Calibration Block

The basic calibration block for straight beam shall be fabricated from material of the same nominal composition as the component to be examined. It shall be threaded like the component being examined. Calibration reflectors shall be notches machined one thread deep or 1/8-inch deep, whichever is smaller, from the base of the thread root and shall follow the lead angle of the thread. The depth location of these reflectors will be such that a distance amplitude correction (DAC) curve can be established covering the full examination distance. Approved drawings of the basic calibration blocks are contained in the applicable SwRI Examination Plan.

4.4 Search Units

(1) The size of the straight-beam longitudinal-wave search units shall be selected from the following:

1/4" Round
3/8" Round

(2) The nominal search unit frequency shall be 2.25, 5.0, 7.5, or 10 MHz, whichever obtains the best resolution of the calibration reflectors. The Level II examiner shall select the search unit frequency based upon resolution of calibration reflectors and/or previous examination data.

(3) The FREQ MHz control shall be set as follows:

Frequency Select	Search Unit Frequency
2	2.25 MHz
5	5.0 MHz
Broadband	7.5 Mhz
10	10.0 MHz

4.5 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 SwRI NPOP 12.0-NDES-107.

4.6 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. Deionized water, when used, shall be supplied by the Public Service Electric and Gas Company (PSE&G).

(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.

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

5. CALIBRATION

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

5.1 Straight-Beam Distance Calibration

Observing back reflections from the applicable reference block, set up a linear sound path distance along the instrument screen baseline, which shall be the smallest applicable size to include at least 10% of the screen distance past the last calibration point.

5.2 Straight-Beam Distance Amplitude Correction

(1) Place the search unit on the basic calibration block surface corresponding to the examination contact surface. Position the search unit to obtain maximum response from the reflector producing the highest amplitude.

(2) Set this response to 75% ±5% of full screen height (FSH) and mark the amplitude on the instrument screen.

(3) Without changing the gain controls, obtain maximum response from each of the remaining reflectors; mark and join all amplitude points with a smooth curved line, extended to cover the required examination range.

5.3 Secondary DAC Calibration

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 20% of FSH or greater, adjacent to a DAC point that falls below 20% of FSH, shall be brought to the primary reference level and marked on the instrument screen. The adjacent point(s), previously at less than 20% of

FSH, 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.

> **NOTE**
>
> When the first DAC point is the only point above 20% of FSH, the next highest point shall be brought to the primary reference level and marked on the instrument screen. The other points previously at less than 20% of FSH shall be marked on the screen and all points connected with a smooth curved line.

5.4 Sweep Range and DAC Curve Verification

Sweep range calibration and DAC curve shall be verified on the appropriate reference and basic calibration block when any of the following occur:

(1) Prior to a series of examinations

(2) With any substitution of the search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.4.1 Calibration Changes

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

(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% 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.

5.4.2 Recalibration

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

(1) Search unit transducer or wedge

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

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

5.4.3 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

> **NOTE**
>
> It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors are readily observable at scanning speed.
>
> The following statement shall be documented on the SwRI Calibration Record Sheet and initialed: "Calibration Reflectors have been verified at Scanning Speed."

6. EXAMINATION

6.1 Examination Areas

The thread root area of pressure-retaining studs and bolts greater than 1 inch to less than 3 inches in diameter with a length of 4 inches to 16 inches shall be examined ultrasonically from both ends or, if installed, the accessible end or ends of the stud or bolts.

6.2 Surface Conditions

The contact surfaces of the pressure-retaining studs or bolts shall be free from roughness or foreign particles which interfere with free movement of the search unit or impair the transmission of ultrasound.

6.3 Examination of Pressure-Retaining Studs and Bolts

(1) A straight-beam longitudinal-wave search unit shall be applied to both ends or the accessible end of the installed pressure-retaining stud or bolt. The entire accessible ends shall be scanned with prime attention given to indications propagating from the thread root area.

(2) Studs and bolts that are not installed shall be examined from both ends.

6.4 Scanning

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

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

(a) 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 (machined notch).

(b) 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 any method that yields a signal response within ±2 of 80% of FSH.

(c) This amplitude and method shall be recorded on the swRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

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

(4) The search unit movement rate shall not exceed 6 inches per second.

6.5 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) Ultrasonic reflectors producing a response 50% or greater of the reference level shall be recorded on the appropriate SwRI Ultrasonic Examination Record for Bolting.

(3) Scanning limitations shall be recorded.

(4) Recorded indications shall be investigated and resolved on the appropriate SwRI Indication Resolution Record by a Level II or Level III examiner to determine the shape, identity, and location of the reflector (i.e., plot, profiles, review of radiographs, etc.).

(5) Indications investigated and resolved to be other than geometric in nature shall be reported to PSE&G for evaluation.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior insevice examinations (PSI, ISI, special examinations, etc). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI-NDTR Form No.	Revision Date
17-19	12-01-83
17-27	04-05-76
17-31	03-14-79

SOUTHWEST RESEARCH INSTITUTE
NUCLEAR PROJECTS
OPERATING PROCEDURE

Title

MANUAL ULTRASONIC EXAMINATION OF HEXAGONAL NUTS

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-10	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: John C. Ianelli Date: 2/26/90

Technical Review: Jack A. Godin Date: 26 FEB 90

Approved By: David Frank Rosow Date: 2/26/90
Department Director

SwRI Form QA-3A-0

MANUAL ULTRASONIC EXAMINATION OF HEXAGONAL NUTS

SAM2-UT37

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure a proper ultrasonic examination of hexagonal nuts in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

(2) Hexagonal nuts shall be examined ultrasonically using shear-wave angle-beam, longitudinal-wave straight-beam, manual, contact, pulse-echo techniques in accordance with this procedure.

(3) Hexagonal nuts greater than 1 inch in diameter shall be examined as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel conducting ultrasonic examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101 "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Blocks

Reference blocks used for screen distance calibration and verification shall be made of carbon steel and shall be one of the following: (1) SwRI Half-Round, (2) AWS-type DC, (3) IIW, or (4) RSR.

4.3 Basic Calibration Block

The basic calibration block shall be a threaded block fabricated from material of the same nominal composition, diameter, and geometry as the hexagonal nuts being examined. Calibration reflector notches for straight-beam shall be machined one thread deep or 1/8-inch deep, whichever is smaller, from the base of the thread root and shall follow the lead angle of the thread. The location of these reflectors will be such that a distance amplitude correction (DAC) curve can be established covering the full path of beam travel. For angle-beam, a notch (maximum of 1/8-inch wide transverse to the direction of the threads) shall be machined to the bottom of the threads ±0.005 inch. Approved drawings of the basic calibration block are contained in the SwRI Examination Plan.

4.4 Search Units

(1) The search units to be used shall be a straight-beam 1/4" or 3/8" round and an angle-beam 1/4" x 1/4" or 1/4" round.

(2) Search unit wedges shall be fabricated to produce 45° ±2° refracted shear waves. A search unit producing 0° longitudinal waves shall also be used.

(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 of the sound beam shall be marked on the search unit wedge.

(4) The nominal search unit frequency for angle-beam shear-wave examinations shall be 2.25 MHz. The straight-beam longitudinal-wave search unit shall be 2.25 MHz.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 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. Deionized water, when used, shall be supplied by Public Service Electric and Gas Company (PSE&G).

(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.

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

5. CALIBRATION METHOD

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) The FREQ MHZ control shall be turned to 2.

(4) All information requested on the SwRI Sonic Instrument Calibration Record shall be entered.

5.1 Straight-Beam Distance Calibration

Observing back reflections from the applicable reference block, set up a linear sound path distance along the baseline of the screen, which shall be the smallest applicable size to include at least 10% of the screen distance past the examination area.

5.2 Angle-Beam Distance Calibration

Observing radius echoes from the applicable reference block, set up a linear sound path distance along the baseline of the screen, which shall be the smallest applicable size to include at least 10% of the screen distance past the examination area.

5.3 Straight-Beam DAC

(1) A search unit, as described in Subsection 4.4, shall be positioned on the most geometrically favorable surface (top or bottom) of the hexagonal nut basic calibration block and a maximum response shall be obtained from the notch which produces the highest amplitude.

(2) Set this signal to 75% ±5% of full screen height (FSH) and record it on the SwRI Sonic Instrument Calibration Record.

(3) Without changing the instrument gain controls, maximum responses shall be obtained from other reflectors to establish a DAC curve, which shall be marked on the instrument screen and extended to include the anticipated examination area.

5.4 Angle-Beam DAC

> **NOTE**
>
> A nonrelevant echo from the inside surface of the hexagonal nut may be observed. This echo shall be disregarded during calibration and examination.

(1) Position the search unit on the outside surface of the basic calibration block. Obtain the maximum response from the notch transverse to the threads with the search unit at position number 1 or number 2 (Figure 1), whichever produces the highest amplitude.

(2) Set this response to the primary reference level of 75% ±5% of FSH, and without changing the instrument gain controls, position the search unit at the other position (Figure 1) to establish a DAC curve, which shall be marked on the instrument screen.

5.5 Secondary DAC Calibration for Straight-Beam

If all points on the straight beam 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 20% of FSH or greater, adjacent to a DAC point that falls below 20% of FSH, shall be brought to the primary reference level and marked on the instrument screen. The other point(s), previously at less than 20% of FSH, 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.

> **EXCEPTION**
>
> When the first DAC point is the only point above 20% of FSH, the next highest point shall be brought to the primary reference level and marked on the instrument screen. The other points previously at less than 20% of FSH shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall also be recorded.

5.6 Sweep Range and DAC Curve Verification

Sweep range calibration and DAC curve shall be verified on the appropriate reference and basic calibration block when any of the following occurs:

(1) Prior to a series of examinations

(2) Substitution of search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examinations

(5) At the completion of a series of examinations

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

5.6.1 Calibration Changes

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

(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% 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.

5.6.2 Recalibration

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

(1) Search unit wedge or transducer

(2) Ultrasonic instrument

(3) Examination personnel

(4) Couplant

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

5.6.3 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record and initialed: "Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination Areas

Hexagonal nuts shall be examined ultrasonically from the most geometrically favorable surface (top or bottom) with straight beam, and the outside surface with angle beam. The examination shall achieve 100% coverage of the hexagonal nut.

6.2 Surface Condition

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

6.3 Scanning

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

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

(a) 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 (machined notch).

(b) 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; choose any method that yields a signal response within ±2% of 80% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used for all scanning during the valid calibration period.

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

(4) The search unit movement rate shall not exceed 6 inches per second.

6.4 Straight-Beam Examination

Position the 0° search unit on the surface (top or bottom) of the hexagonal nut which corresponds to the calibration surface. Manipulate the search unit in such a manner, that the entire volume of the nut is scanned from this surface. Calibration for the 0° longitudinal-wave examination shall be in accordance with Subsections 5.1 and 5.3.

6.5 Angle-Beam Examination

Position the 45° search unit on the outside surface of the nut in such a manner, that the sound beam follows the direction of the threads. Examine the thread root area from each of the six flat outer surfaces for the full width of the nut from two opposing directions. Calibration for this examination shall be in accordance with Subsections 5.2 and 5.4.

6.6 Postexamination Cleaning

Arrangements shall be made with PSE&G for postexamination removal of couplant materials.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) Ultrasonic reflectors producing a response 50% or greater of the reference level shall be recorded on the appropriate SwRI Ultrasonic Examination Record for Bolting.

(3) Recorded indications shall be investigated and resolved by a Level II or a Level III examiner to determine the shape, identity, and location of the reflector.

(4) Indications investigated and found to be other than geometrical in nature shall be reported to PSE&G for evaluation.

(5) Scanning limitations shall be recorded.

8. DATA COMPARISON

Inservice nondestructive examination results shall be compared with recorded results of the preservice examination and prior inservice examinations (PSI, ISI, special examinations, etc.). As a minimum, review prior data to determine the presence and location of flaws.

9. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000.

10. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI NDTR Form No.	Revision Date
17-19	12-01-83
17-27	04-05-76

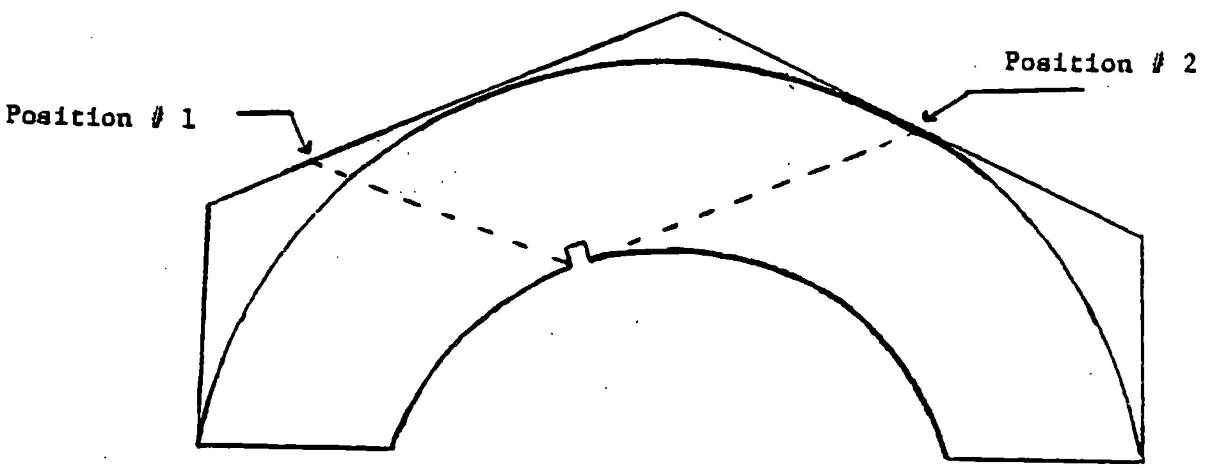

Figure 1. Calibration positions

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SAM2-UT39 Rev. 0, Chg. 0 April 1990 Page 1 of 13

Title **MANUAL ULTRASONIC EXAMINATION OF SMALL-DIAMETER PIPING WELDS**

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-13	0	4/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Alfred R. Anderson Date: 30 APR 1990

Technical Review: [signature] Date: 30TH APRIL 1990

Approved By: David Frank Rosow Date: 5/1/90
Department Director

SwRI Form QA-3A-0

MANUAL ULTRASONIC EXAMINATION OF SMALL-DIAMETER PIPING WELDS

SAM2-UT39

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps necessary to ensure a complete and accurate manual ultrasonic examination of small-diameter circumferential piping welds in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

(2) Angle-beam shear-wave, straight-beam longitudinal-wave, manual, contact, pulse-echo ultrasonic techniques shall be employed for weld examination of 1.5- to 2.5-inch nominal diameter circumferential piping. Circumferential piping welds and adjacent base material with a 0.1- to 0.4-inch nominal thickness shall be examined as specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition, with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition, with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Reference Blocks

(1) Reference blocks used for screen distance calibration and verification shall be of the same basic material as the production material; i.e., carbon steel or stainless steel, and shall be one of the following: (1) SwRI Half Round, (2) AWS-type DC, (3) IIW, or (4) SwRI pipe reference block (PRB).

(2) The actual refracted beam angle of 45° ±2° shear-wave search units shall be determined on the PRB. The curvature of the PRB shall conform to the nominal curvature of the examination area; i.e., a 1.5-inch nominal diameter pipe shall require a 1.5-inch diameter PRB to be utilized.

(3) The actual refracted beam angle of 70° ±2° search units shall be determined on the basic calibration block.

4.2.1 Straight-Beam Reference Block Selection

Screen Distance	Block Type	Block Dimension
0.5"	AWS-type DC	0.5"
1.0"	SwRI Half-Round	1.0"
	AWS-type DC	0.5" or 1.0"
	IIW	1.0"

4.2.2 Angle-Beam Reference Block Selection

Screen Distance	Block Type	Block Dimension
1.0"	AWS-type DC	1.0" Radius
2.0" or 2.5"	SwRI Half-Round	1.0" Radius
	AWS-type DC	1.0" or 2.0" Radius

4.3 Basic Calibration Block

(1) The basic calibration block shall be fabricated from material of the same or equivalent P-number grouping as the production material, as specified in Section IX of the ASME Code. P-numbers P-1, P-3, P-4, and P-5 shall be considered equivalent for the purposes of this examination.

(2) Calibration reflectors shall be notches machined on the outside and inside surfaces of the basic calibration block. The notches shall be in accordance with approved drawings of the basic calibration block contained in the applicable SwRI Examination Plan.

(3) The basic calibration block shall be made of material of the same nominal diameter and nominal wall thickness or pipe schedule as the pipe to be examined.

4.4 Search Units

Search units shall be selected from the following:

(1) Straight-Beam Longitudinal-Wave

(a) The search unit shall be either a 1/4" Aerotech (Diamond) Gamma MSWS or a 1/4" Round Dual Element.

(b) A 1/4" round longitudinal-wave dual-element search unit shall be used at a frequency of 2.25 MHz or 5.0 MHz. A 1/4" Aerotech (Diamond) Gamma MSWS search unit shall be used only at a frequency of 5.0 MHz.

(c) A delay line shoe shall be attached if a 1/4" Aerotech (Diamond) Gamma MSWS search unit is used.

(2) Angle-Beam Shear-Wave

Nominal Production Material Thickness	Nominal Search Unit Size
0.1" to 0.4"	1/4" x 1/4" Aerotech (Diamond) Gamma MSWS

(a) The nominal angle-beam shear-wave search unit frequency shall be 5.0 MHz.

(b) The search unit wedges shall be fabricated as required to produce a 45°±2° and 70° ±2° refracted shear waves. The contact surface of the wedges shall conform to the surface of the pipe for the examination being conducted.

(c) The search unit exit point shall be marked on the wedge in line with the screw holes.

4.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by SwRI NPOP 12.0-NDES-107.

4.6 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 the procedure. Deionized water, when used, shall be supplied by Public Service Electric & Gas Company (PSE&G).

(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.

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

5. CALIBRATION METHOD

(1) The ultrasonic calibration shall be completed prior to the examination.

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

(3) All information blocks on the SwRI Sonic Instrument Calibration Record shall be completed.

(4) The FREQ MHZ control shall be turned to 2 when a 2.25-MHz search unit is used and to 5 when a 5.0-MHz search unit is used.

5.1 Straight-Beam Distance Calibration

(1) 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.

(2) Attach a delay line shoe if a 1/4" x 1/4" Aerotech (Diamond) Gamma MSWS search unit is used.

(3) Position the straight-beam search unit on an appropriate reference block, observe the back reflections, and set up the required linear sound path distance along the screen baseline.

(4) Screen distance shall be selected from the following sizes: 0.5" or 1.0".

5.2 Angle Determination

(1) The actual refracted beam angle of 45° ±2° search units shall be determined on the PRB as follows:

(a) Select a PRB with the same nominal curvature as the examination surface and wedge.

(b) Peak the signal from the hole parallel to the block axis for transverse wedges and the hole perpendicular to the block axis for nontransverse wedges.

(c) Read the actual refracted angle in line with the exit point scribed on the wedge.

(d) This angle shall be 45° ±2°.

(2) The actual refracted beam angle of 70° ±2° search units shall be determined on the basic calibration blocks as follows:

(a) Peak the signal from the inside surface notch perpendicular to the basic calibration axis (circumferential notch).

(b) Measure the skip distance from the notch to the scribed exit point of the wedge.

(c) The measured skip distance shall be between 2.5 to 3.1 times the actual basic calibration block thickness.

5.3 Angle-Beam Distance Calibration

Distance calibration shall be performed using the appropriate reference block and calibration block as follows:

(1) Screen distance shall be selected from the following sizes: 1.0", 2.0", or 2.5".

(2) Couple a flat wedge to the search unit. Observe the radius echoes from the applicable reference block and set up a linear sound path distance along the screen baseline which shall include 1/8 vee-path beyond the anticipated examination distance. Couple the search unit to the wedge for the nontransverse examinations.

(3) Calculate or measure the metal path to the 4/8 vee-path position on the applicable calibration block.

(4) Obtain the peak response from the 4/8 vee-path position.

(5) Using only the DELAY control, set the signal on the appropriate position on the screen baseline. Observe the 4/8 notch signal and record all required verification block entries on the SwRI Sonic Instrument Calibration Record.

(6) Obtain the peak response from the 4/8 vee-path position using the search unit required for the transverse examinations. Without changing the screen distance, observe and record all required data entries.

(7) No attempt shall be made to compensate for any delay difference between the nontransverse and transverse search units. This difference shall be considered when resolving indications.

5.4 Straight-Beam Distance Amplitude Correction (DAC)

A straight-beam DAC curve shall not be constructed with this procedure.

5.5 Angle-Beam DAC

NOTE

DAC curves shall be constructed from the notches perpendicular to the axis of the calibration block when using the nontransverse wedge. DAC curves shall be constructed from the axial notches for calibrations requiring the transverse wedge.

(1) Position the angle-beam search unit on the calibration block to obtain maximum response from the vee-path position selected from the following, that produces the highest amplitude:

45° ±2° Vee-Path Positions	70° ±2° Vee-Path Positions
4/8, 8/8, 12/8	4/8, 8/8

(2) Set this response to 75% ±5% of full screen height (FSH) and mark its amplitude on the screen. The gain controls shall not be adjusted once the primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line which shall extend no more than 1/8 vee-path past the last qualified calibration point.

5.6 Secondary DAC Calibrations

Each point on the DAC curve shall appear at a minimum of 20% of FSH or 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 20% of FSH or greater and adjacent to a DAC point that falls below 20% of FSH shall be brought to the primary reference level and marked on the instrument screen. The other point(s), previously at less than 20% of FSH, 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 8/8 vee-path position is set at the primary reference level, and the 4/8 and/or 12/8 vee-path position is below 20% of FSH, a secondary DAC curve is not required.

When the first DAC point is the only point above 20% of FSH, 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 20% of FSH shall be marked on the screen. All points shall be connected with a smooth curved line. The gain setting for this secondary DAC curve shall also be recorded.

A secondary DAC curve is not required with the 70° ±2° search unit.

5.7 Calibration Verification

5.7.1 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) Prior to a series of examinations

(2) With any substitution of search unit cable

(3) With any substitution utilizing the same type of power source; e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

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

5.7.2 Calibration Changes

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

(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% 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.

5.7.3 Recalibration

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

(1) Search unit wedge or transducer

(2) Couplant

(3) Ultrasonic instrument

(4) Examination personnel

(5) Type of power source; e.g., a change from direct to alternating current

5.7.4 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed.

NOTES

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors is readily observable at scanning speed.

The following statement shall be documented on the SwRI Calibration Record Sheet and initialed:

"Calibration reflectors have been verified at scanning speed."

6. EXAMINATION

6.1 Examination Areas

(1) This procedure shall apply to ultrasonic examination from the outside surface of 1.5- to 2.5-inch nominal diameter pressure piping circumferential welds and adjacent base material with a 0.1- to 0.4-inch nominal thickness.

(2) Base material adjacent to circumferential welds shall be examined for a minimum distance of 1.0 inch from the fusion line of the weld on each side of the weld.

NOTE

The examination of circumferential welds shall be conducted only from the pipe side of the weld when piping components are welded to the pipe. This applies to the circumferential and axial scans.

6.2 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.

6.3 Attenuation

Attenuation measurements shall not be performed.

6.4 Indication Length Zero Reference (L_0) Location

Areas to be examined in accordance with this procedure shall have an L_0 marked in accordance with the applicable revision of SwRI NPOP SwRI-NDE7.

6.5 Scanning

(1) When practical, scanning shall be performed at a minimum gain setting of 5 times the reference level sensitivity.

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

(a) With the instrument at the primary reference level, manipulate the search unit on the basic calibration block to obtain a signal of 20% of FSH from a calibration reflector (machined notch).

(b) Add 14 dB gain by utilizing the 14 dB switch (if present), the fine gain control, or a combination of the fine and coarse gain controls and choose any method that yields a signal response within ±2 of 100% of FSH.

(c) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 5 times the reference level sensitivity.

(4) Search unit movement rate for scanning shall not exceed 3 inches per second.

(5) Scanning overlap shall be a minimum of 25% of the search unit piezoelectric element dimension perpendicular to the direction of scan.

6.6 Base Material Lamination Scan

Before the angle-beam examination, a lamination scan using longitudinal wave shall be performed. This scan shall cover the entire area through which the angle beam is to be passed. The lamination scan shall be conducted as follows:

(1) Screen distance calibration for this examination shall be conducted in accordance with Subsection 6.1.

(2) Scanning sensitivity shall be as required to maintain the first back reflection at an amplitude of between 50% and 90% of FSH.

(3) To record an intermediate indication, a back reflection signal shall be obtained from an indication-free area and the instrument gain control adjusted until this signal is at 75% ±5% of FSH; record the intermediate indication when its amplitude is equal to the remaining back reflection. Areas of total loss of back reflection accompanying the intermediate echo shall also be recorded.

6.7 Circumferential Welds

6.7.1 Thickness Measurements

Thickness measurements shall be taken at a minimum of two points (in the base material on each side of the weld). Screen distance calibration for this examination shall be in accordance with Subsection 5.1. Measurements shall be taken by placing the straight-beam search unit on the examination surface and recording the position of the back wall reflection observed on the instrument screen.

6.7.2 Angle-Beam Examination for Indications Parallel with the Weld

(1) Calibration for these examinations shall be in accordance with Subsections 5.3 and 5.5.

(2) An angle-beam examination shall be accomplished using a 45° and 70° refracted shear-wave from the pipe side of the weld. The sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld.

(3) When an examination cannot be accomplished from both sides of the weld, a 45° and 70° refracted shear-wave examination shall be accomplished from one side of the weld.

6.7.3 Angle-Beam Examination for Indications Perpendicular to the Weld

An angle-beam examination shall be conducted on the base material on the pipe side of the weld by placing the 45° shear-wave search unit on the surface of the pipe base material with the sound beam directed parallel with the weld to detect indications perpendicular to the weld. The entire length of the weld and the adjacent base material shall be scanned with the search unit directed in this manner from two opposing directions. Scanning coverage for this examination shall extend a minimum of 1 inch from the weld fusion line.

7. RECORDING, RESOLUTION, AND REPORTING CRITERIA

(1) Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE3.

(2) The following ultrasonic indications shall be recorded and investigated by a Level II or Level III examiner to determine the shape, location, and identity of the reflector:

(a) All ultrasonic reflectors, regardless of signal amplitude, not attributable to geometry. Examples of nongeometric reflectors 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.

(b) Geometric indications that have amplitudes equal to or greater than 20% of the reference level.

NOTE

Geometric indications shall be recorded only once, even if the amplitude of the indication drops below the required recording amplitude along the weld.

(3) All ultrasonic indications, regardless of amplitude and not attributable to geometry, shall be evaluated by a Level II or Level III examiner in accordance with the acceptance criteria outlined in Section 8.

(4) If indications have been recorded as geometry and are found to be nongeometric reflectors, the entire weld shall be reexamined and all nongeometric reflectors and other reflectors not previously recorded at least once shall be recorded.

(5) Indications investigated and found to be other than geometric in nature, regardless of amplitude, shall be reported to the customer for final evaluation and disposition.

(6) Sizing of indications shall not be conducted with this procedure.

(7) Scanning limitations shall be recorded on the SwRI Examination Record.

8. EVALUATION

Initial evaluation of reportable indications shall be performed by SwRI personnel, and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, IWA-3000. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G.

9. RECORDS

(1) Documents generated in accordance with this procedure shall be stored in the Division 17 record vault or as specified by PSE&G.

(2) The applicable examination records are:

SwRI-NDTR Form No.	Revision Date
17-18	7-31-75
17-19	12-1-83
17-25	3-14-79
17-126	1-15-86
17-127	1-15-86

Title **ULTRASONIC THICKNESS MEASUREMENT OF PIPING, VESSELS, AND COMPONENTS USING THE SwRI THICKNESS DATA ACQUISITION SYSTEM**

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Department Director

ULTRASONIC THICKNESS MEASUREMENT OF PIPING, VESSELS, AND COMPONENTS USING THE SwRI THICKNESS DATA ACQUISITION SYSTEM

SwRI-UT122

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure proper calibration, ultrasonic (UT) thickness measurement and data acquisition using the Southwest Research Institute (SwRI) Thickness Data Acquisition System (TDAS).

(2) Manual, contact, straight-beam, longitudinal-wave UT techniques shall be utilized for the thickness measurement of piping, vessels, and components in the nominal thickness range of 0.05 to 2.5 inches.

2. APPLICABLE DOCUMENTS

SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel

Personnel performing ultrasonic thickness measurements shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification." With permission of the customer, trainees familiar with this procedure may be used as examiners.

4.2 Equipment

The following equipment comprises the TDAS:

(1) Sonic Mark I UT instrument aligned and displaying a valid alignment calibration tag in accordance with SwRI NPOP 12.0-NDES-107.

(2) TDAS Digital Interface unit shall be attached to the UT instrument and provide the necessary signal processing and output for recording of thickness measurements.

(3) Polycorder data storage unit attached to the TDAS Digital Interface for recording of thickness data.

(4) Send Command Switch which will allow the operator to control the recording of data.

4.2.1 Calibration Blocks

(1) Step thickness blocks shall be used for screen distance calibration and verification. The block used for calibration/verification shall be of the same basic material as the material to be measured.

(2) The step thickness block(s) shall provide a minimum of two calibration points within the full screen distance size chosen (see Subsection 5.3). When a contoured wear face is used on the transducer, the step thickness block shall be curved.

4.2.2 Search Unit

(1) Search units shall be selected from the following sizes:

1/8" Round
1/4" Round
3/8" Round

(2) The nominal search unit frequency should be 2.25, 5.0, or 10.0 MHz. A dual-element search unit shall be used for nominal thicknesses less than 0.25". For thicknesses 0.25" and greater, a single-element search unit should be used. The search unit wear face shall be flat and straight unless the component curvature prevents adequate contact with the surface, in which case a contoured wear face may be used.

NOTE

Other search unit frequencies and sizes may be used if demonstrated to give equal or better results.

4.2.3 Thermometer

The thermometer to be used for measuring the calibration block and component temperatures shall be calibrated and certified and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

4.3 Couplant

(1) Sonotrace 30, Sonotrace 40, Ultragel II, or other couplants approved by the customer shall be used when performing UT calibrations and examinations in

accordance with this procedure. For high temperature applications, Thermasonic 50, Krautkramer GmbH, or other approved couplant may be used.

(2) Couplant materials shall be certified for sulfur content and total halogens in accordance with SD-129 and SD-808 of Article 24, Section V. The residual amount of total sulfur or halogens shall not exceed 1% by weight.

5. CALIBRATION

5.1 Temperature Requirements

The basic calibration block and component temperature shall be within 25°F. The temperatures shall be recorded on the applicable record for initial calibration and each verification. The surface temperature of the component to be measured shall be taken prior to performing measurements and recorded on the applicable record.

5.2 Preliminary UT Instrument Setup

(1) The examiner shall assure the "Low Battery" charge indicator light is out during instrument use.

(2) The instrument shall be warmed up a minimum of 10 minutes prior to use.

(3) The TDAS record cable jack must be plugged into the TDAS unit.

(4) The controls on the Sonic FTS Mark I shall be set as follows prior to calibration:

> **NOTE**
>
> The following instrument settings are initial settings. The examiner may require different settings for some instrument and search unit combinations. It is imperative that the Sonic controls be used as necessary to obtain a straight and vertical leading edge for the reflected signal.

(a) POWER/OFF switch set to power

(b) RANGE switch set as required

(c) DELAY coarse switch set to position 1

(d) FREQ-MHz switch set to 2 for 2.25-MHz search units, 5 for 5.0-MHz search units and to 10 for 10.0-MHz search units.

(e) DAMPING switch initially set to MIN

(f) Mode switch set to THRU TRANS or NORMAL as appropriate

(g) REP RATE switch set to 3K

(h) FILTER switch set to HI

(i) VIDEO switch set to DIFF

(j) DEC START, if applicable, turned all the way counterclockwise

(k) DEC SLOPE, if applicable, turned to OFF

(l) REJECT CONTROL to be used as necessary to provide a clean baseline

(m) Search unit cables connected to R and T jacks for dual-element search units and to the R jack for single-element calibration.

5.3 Sonic MK I Calibration

The full screen distance size shall be at least 0.200 inch beyond the anticipated examination range. The appropriate step thickness block shall be utilized to construct a linear sound path using a minimum of two steps that encompass the thickness of the component to be examined.

5.4 TDAS Calibration

5.4.1 Mode Switch

Position the MODE switch to the "single" (single backwall) position. This means that the digital electronic circuit will start the "clock" at the beginning of the gate and stop the "clock" at the leading edge of the first signal within the gate to break the threshold level.

5.4.2 Gate Position and Width

(1) Whereas the Sonic instrument screen can be linearly calibrated over a very large thickness range including "0" thickness, the TDAS instrument circuitry is currently designed to only be calibrated over a narrow range (gated region). This range varies slightly from instrument to instrument, but for the purpose of this procedure it should be considered to be a maximum of 1.500 inches. The position of the gate, however, can be moved over a very broad range, easily including the limits specified in this procedure. The purpose of the following paragraphs is to provide instruction as to the proper positioning and width adjustment of the TDAS gate.

(2) Adjust the Gate Position and Width as follows:

(a) The position of the TDAS gate is indicated on the Sonic cathode-ray tube (CRT) screen by the portion of the baseline that is raised. Turn the TDAS gate marker switch to the ON position.

(b) Set the Sonic Range switch on a range that allows both ends of the gate marker to be visible in the Sonic screen. It may also be necessary to adjust the Sonic Delay control and/or to use the TDAS Pulse Delay control to bring the gate marker left edge into view. Use the Pulse Delay knob on the TDAS to adjust the left side of the gate approximately 0.200 inch to the left side of the signal received from the thickness step used for the lower end of the TDAS calibration range. For a 0.100- to 0.500-inch TDAS calibration, the FINAL position of gate left edge will be just off the left side of the Sonic screen.

(c) Using the TDAS Pulse Width knob, adjust the right side of the gate to approximately 0.200 inch past the anticipated thickness range. If the Sonic coarse Range control has to be positioned at more than one position greater than the final calibration position, it will be appropriate to decrease the coarse Range as the gate width decreases; i.e., follow the gate at appropriate intervals as it narrows. The total gate width should in no case be greater than 1.500 inches and should be the smallest width necessary. This will assure the greatest possible TDAS accuracy.

(d) Return the Sonic RANGE and DELAY Controls to the settings previously established for screen calibration.

5.4.3 Threshold

Adjust the Threshold as follows:

Place the search unit on an appropriate step thickness at the lower end of the calibration range and adjust the amplitude to within the range of 30% to 40% of full screen height (FSH). Using the threshold knob, adjust the threshold such that the digital meter glows brightly with the signal between 30% and 40% of FSH but goes blank with signal below 30% of FSH (clockwise raises the threshold).

5.4.4 Final Gate Adjustment

Make final gate adjustments as follows:

(1) With no further change of the Sonic Range or Delay controls, place the search unit on the thickness step used for the lowest end of the calibration range and adjust the signal amplitude to 80% of FSH.

(2) Adjust the left side of the gate using the TDAS Pulse Delay knob until the lowest stabilized number appears in the digital display. As the gate is adjusted, the numbers in the display will decrease to the point where they begin to flicker and then blank out. The adjustment is correct when the number appearing in the display is as low a value as possible while remaining bright and stable.

5.4.5 TDAS Digital Display Calibration

Calibrate the Digital Display as follows:

(1) By observing the TDAS digital display as the search unit is applied to at least three step block thicknesses (including the lowest thickness), assure that the digital readings are positive rather than negative. If any step yields a negative number, use the TDAS "Zero" control to correct this situation.

(2) Place the search unit alternately on two steps which encompass the expected examination range. With each signal at 80% of FSH, make note of the digital display. Using the TDAS range, adjust the digital display to obtain the appropriate digital reading spread. Repeat this calibration on an additional step within the gate and one of the first steps to insure linearity.

(3) After the digital reading spread is obtained, place the search unit on the lowest step used and adjust the TDAS "Zero" control so that the display indicates the correct thickness.

(4) Verify that all gated steps produce a readout within ±.005 inch on the digital display. Each signal should be 80% to 100% of FSH. If any step readout fails to be within the ±.005-inch tolerance, return to step (2) above. These readings shall be recorded on the applicable SwRI calibration sheet.

5.5 Polycorder Programming for Data Collection

NOTES

At any time during steps (2) through (14), entry errors (errors that are entered by depressing the "ENTER" key) may be corrected by returning to step (4). To return to step (4), press "ESC".

Key stroke errors that have not yet been entered can normally be corrected by depressing the left hand arrow key.

Perform the following steps to program the Polycorder for data collection:

(1) To assure that a false reading is not recorded in the first line of the Polycorder data file, it is recommended that the thickness gauge is on and calibrated preceding Polycorder setup.

(2) Turn the Polycorder on by depressing the "ON" key. The Polycorder will initially display a log-on message which includes either "516B" or "516C". This is the model number. The display window will then show "MODE ?__".

(3) Upon initial use of the Polycorder; i.e., first site to be measured after the Polycorder memory has been transferred to the computer, the examiner must assure that data are cleared by executing Mode 4-3 as follows:

		Display
(a)	Press 4	"FILE 1, 2, 3 DIR, ERA-F, ERA-D"
(b)	Press 3	"ERASE DATA FILE = PDATA
(c)	Press ENTER	"SURE? (Y/N)"
(d)	Press SHF	"ERASE DATA FILE"
(e)	Press Y	"DONE"
(f)	ESC	"MODE?"

(4) Depress the "0" and use the up arrow key to select "EXECUTE PROGRAM FILE: Record."

(5) Press the "ENTER" key.

(6) The display window temporarily indicates "MEMORY AVAILABLE." This number will be displayed on screen and will aid examiner on keeping track of Polycorder available memory during examination.

(7) The display window now indicates TDAS=0, 26DL=1. Press 0 and then "ENTER."

(8) The display window now indicates "FILE CODE=". The File Code will be selected by the Team Supervisor for the specific area to be examined. Press the one-digit key corresponding to the desired code, 0-9, and press "ENTER".

(9) The display window now indicates "ENTER DIRECTION X=0 Y=1". Enter a "0" if the scan direction is in the X direction or enter "1" if the scan direction is in the Y direction (for piping and vessels, "X" is typically in circumferential direction, while "Y" is in the axial or longitudinal direction). Press the "ENTER" key.

(10) The display window now indicates START X = _". Enter the starting "X" position. (The starting position will normally be "0".) Press the "ENTER" key.

(11) The display window now indicates "END X = _". Enter the applicable "X" corresponding to the last "X" on the grid pattern. Press the "ENTER" key.

(12) The display window now indicates "X INCREMENT _". This is the distance between Grid Points in inches in the "X" direction. Press the "ENTER" key.

(13) The display window now indicates "START Y = _". Enter the appropriate "Y" data following the same steps as (9), (10), and (11) above.

(14) After entering the "Y" information above, the screen will show only a "_." It is ready for the first measurement.

5.6 Calibration Verification

Calibration shall be verified as stated in Subsection 5.4.

(1) Prior to a series of measurements

(2) At approximately 30-minute intervals not to exceed 1 hour

(3) At the completion of a series of measurements

(4) With a change in personnel, power source, or search unit.

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

5.7 Recalibration

Perform the following if a change of ±0.005 inch from the actual thickness value is noted.

(1) Void all measurements performed after the last valid calibration verification.

(2) Correct the calibration.

(3) Remeasure the voided areas.

6. EXAMINATION

NOTE

The Polycorder must NOT be disconnected from the thickness gauge while data are being taken or the unit is on. Disconnection of the Polycorder may result in the loss of data.

Areas to be examined will be identified by the customer. The entire area of examination will be marked by a grid pattern drawn on the surface of the component with customer-approved marker. The grid pattern will be as specified by the customer.

Adequate contact may not be possible on pitted surfaces. Where possible, arrangements shall be made with the customer for removal of any surface condition which prevents adequate contact.

(1) Place the search unit on the pipe at the starting X/Y location. Obtain a valid digital display reading. Momentarily press the Send Command Switch to enter the data.

After the first reading is taken, the Polycorder will indicate the "X" and"Y" coordinate location, X=0 and Y=0, and the thickness reading recorded. For each successive data point, the Polycorder will indicate the last coordinate location and the thickness recorded.

(2) Continue taking readings as in (1) by advancing in the scan direction as entered in the Polycorder [see Paragraph 6(9)].

(3) For any location where a measurement cannot be obtained, enter a "0" reading by lifting the transducer from the examination surface (making sure that the couplant doesn't cause a spurious signal) and depressing the Send Command switch.

(4) Upon reaching the limits of the grid established in the Polycorder, the Polycorder software will display the final recorded thickness measurement and its associated parameters.

(5) After completion of a grid or grid segment, further measurements may be recorded (subject to the memory capacity) by pressing ESC and then proceeding to the Polycorder setup steps beginning with Paragraph 6(4). The Polycorder software is designed to terminate data recording just prior to reaching full capacity, and no further data transmission will be allowed until the Polycorder memory is cleared.

(6) When finished taking measurements, turn the Polycorder off, by depressing the "ESC" and then the "9."

7. EVALUATION

The thickness measurements taken in accordance with this procedure shall be evaluated by the customer, or customer's representative.

8. RECORDS

(1) Data generated in accordance with this procedure will be in the form of computer printouts. Additionally, all computer report files (*.RPT) will be recorded on floppy diskettes for future reference. A copy of each data diskette will also be made available to the customer if so desired. An examination report and location of record storage is at the option of the customer.

(2) The applicable examination record is as follows:

SwRI NDTR Form No.	Revision Date
17-133	03/27/90

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SwRI-UT123 Rev. 1, Chg. 0 March 1990 Page 1 of 9

Title

ULTRASONIC THICKNESS MEASUREMENT OF PIPING, VESSELS, AND COMPONENTS USING MODEL 26DL THICKNESS GAUGE

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-9	0	3/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Lyle Spiess Date: 26 MAR 90

Technical Review: Russell H. Fine Date: 26 MAR 90

Approved By: David Frank Rosow Date: 3/26/90
Department Director

SwRI Form QA-3A-0

ULTRASONIC THICKNESS MEASUREMENT OF PIPING, VESSELS, AND COMPONENTS USING MODEL 26DL THICKNESS GAUGE

SwRI-UT123

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure proper calibration, ultrasonic (UT) thickness measurement, and data acquisition using the Panametrics Model 26DL thickness gauge.

(2) Manual, contact, straight-beam longitudinal-wave UT techniques shall be used for the thickness measurement of piping, vessels, and components in the nominal thickness range of 0.04 to 10.0 inches in accordance with this procedure.

2. APPLICABLE DOCUMENTS

SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel

Personnel performing examinations shall be certified in accordance with Southwest Research Institute (SwRI) Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification." With permission of the customer, trainees familiar with this procedure may be used as examiners.

4.2 Equipment

4.2.1 Instrument

(1) A Panametrics Model 26DL UT instrument aligned and displaying a valid alignment calibration tag shall be used.

(2) Polycorder data storage unit with interface cable may be used for recording of thickness data.

(3) Send Command Switch may be used which will allow the operator to externally control the recording of data.

4.2.2 Calibration Blocks

(1) Step thickness blocks shall be used for screen distance calibration and verification. The block used for calibration/verification shall be of the same basic material as the material to be measured.

(2) The step thickness block(s) shall provide a minimum of two calibration points that will encompass the anticipated thicknesses to be measured. When a contoured wear face is used on the transducer, the step thickness block shall be curved.

4.2.3 Search Unit

A Panametrics Model D790, 5.0 MHz, 5/16" dia search unit should be used.

NOTE

Other search unit frequencies and sizes may be used if demonstrated to give equal or better results.

4.2.4 Thermometer

The thermometer to be used for measuring the calibration block and component temperatures shall be calibrated and certified and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

4.3 Couplant

(1) Sonotrace 30, Sonotrace 40, Ultragel II or other couplants approved by the customer shall be used when performing UT calibrations and examinations in accordance with this procedure. For high temperature applications, Thermasonic 50, Krautkramer GmbH, or other approved couplant may be used.

(2) Couplant materials shall be certified for sulfur content and total halogens in accordance with SD-129 and SD-808 of Article 24, Section V, of the ASME Code. The residual amount of total sulfur or halogens shall not exceed 1% by weight.

5. CALIBRATION

5.1 Temperature Requirements

The basic calibration block and component temperature shall be within 25°F. The temperatures shall be recorded on the applicable record for initial calibration and each verification. The surface temperature of the component to be measured shall be taken prior to performing measurements and recorded on the applicable record.

5.2 Velocity and Zero Calibration

NOTE

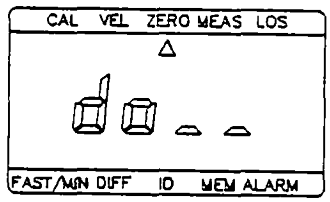
Calibration thickness selection: at least two calibration thicknesses must be used for proper calibration. The thinnest calibration piece must be less than the examination piece thickness range. Likewise, the thickest calibration piece must be greater than the examination piece thickness range.

Step 1: Plug the transducer into the connector at the top end of the 26DL case.

Note that the transducer cable connector must be oriented with center pin up.

When unplugging a transducer, pull ONLY on molded plug, NOT on the cable.

Step 2: Press the [ON/OFF] key to turn the gauge on. (The transducer should NOT be coupled to the test piece.) The display will now show the message:

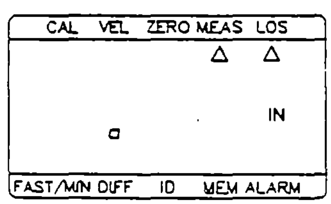


This means that the gauge requires the following Transducer Zero Compensation steps to automatically compensate for the current transducer delay line length.

Step 3: Wipe all couplant from the tip of the transducer.

Step 4: Press the [ZERO] key.

The display will show:



NOTE

Steps 1-4 shall be performed each time the 26DL is turned on.

Step 5: The current units are indicated on the right of the display. To change either inches (IN) or millimeters (MM) to the alternate measurement units, press the [IN/MM] key.

Step 6: Press the [MEAS] key. Then couple the transducer to the thick calibration block.

Press the [CAL] key. When the thickness reading is stable, press the [VEL] key. Remove the transducer and enter the thickness of the thick block.

Step 7: Couple the transducer to the thin block and press the [CAL] key. When the reading is stable, press the [ZERO] key. Remove the transducer and enter the thickness of the thin block. Press the [MEAS] key to complete the calibration and go to the Measure mode.

5.3 Gain Boost

If a signal does not appear on the screen when attempting to record a measurement, follow the procedure below to boost the sensitivity while using a D790 transducer:

Step 1: Press [MEAS] if not already in the Measure mode.

Step 2: Hold [3] down and press [MEAS]. The MEAS flag will flash indicating that the default has been modified.

Step 3: To return to the default sensitivity, press [3] and [MEAS] at the same time again. Also, when the gauge is turned off and then on again, it will restore the default sensitivity.

5.4 Calibration Lock

(1) The Calibration Lock feature allows the gauge to be set so that no calibration values can be altered. This shall be done after completion of calibration. (The Transducer Zero Compensation can still be used without affecting the calibration.)

(2) To set the Calibration Lock, press the [6] and the [9] keys together while in a Measure mode. The lock symbol will turn on after the [6] and [9] keys are pressed together to indicate that the Calibration Lock is being activated. If you press a locked key while the gauge is in the Calibration Lock condition, the lock symbol will be displayed while the key is held down. To release the Calibration Lock, press the [6] and [9] keys together again. The lock symbol will be displayed momentarily to indicate that the Calibration Lock is being released.

5.5 Battery

The gauge will operate for at least 35 hours between charges under normal conditions (FAST mode and backlight off). The battery symbol will appear in the upper left corner of the display when there are approximately two hours of operating time left on the internal battery. When there is insufficient battery charge, the gauge will automatically turn off to prevent damage to the battery.

> **NOTE**
>
> If the battery symbol appears in the upper left corner of the display, a calibration verification shall be performed and the instrument shall be recharged.

6. POLYCORDER PROGRAMMING FOR DATA COLLECTION

> **NOTES**
>
> At any time during steps (2) through (12), entry errors (errors that are entered by depressing the "ENTER" key) may be corrected by returning to step (4). To return to step (4), press "ESC".
>
> Key stroke errors that have not yet been entered can normally be corrected by depressing the left hand arrow key.

Perform the following steps to program the Polycorder for data collection:

(1) To assure that a false reading is not recorded in the first line of the Polycorder data file, it is recommended that the thickness gauge is on and calibrated preceding Polycorder setup.

(2) Turn the Polycorder on by depressing the "ON" key. The Polycorder will initially display a log-on message which includes either "516B" or "516C". This is the model number. The display window will then show "MODE ?__".

(3) Upon initial use of the Polycorder; i.e., first site to be measured after the Polycorder memory has been transferred to the computer, the examiner must assure that data are cleared by executing Mode 4-3 as follows:

		Display
(a)	Press 4	"FILE 1, 2, 3 DIR, ERA-F, ERA-D"
(b)	Press 3	"ERASE DATA FILE = PDATA
(c)	Press ENTER	"SURE? (Y/N)"

(d)	Press SHF	"ERASE DATA FILE"
(e)	Press Y	"DONE"
(f)	ESC	"MODE?"

(4) Depress the "0" and use the up arrow key to select "EXECUTE PROGRAM FILE: Record."

(5) Press the "ENTER" key.

(6) The display window temporarily indicates "MEMORY AVAILABLE." This number will be displayed on screen and will aid examiner on keeping track of Polycorder available memory during examination.

(7) The display window now indicates TDAS=0, 26DL=1. Press 1 and then "ENTER."

(8) The display window now indicates "FILE CODE=". The File Code will be selected by the Team Supervisor for the specific area to be examined. Press the one-digit key corresponding to the desired code, 0-9, and press "ENTER".

(9) The display window now indicates "ENTER DIRECTION X=0 Y=1". Enter a "0" if the scan direction is in the X direction or enter "1" if the scan direction is in the Y direction (for piping and vessels, "X" is typically in circumferential direction, while "Y" is in the axial or longitudinal direction). Press the "ENTER" key.

(10) The display window now indicates START X = _". Enter the starting "X" position. (The starting position will normally be "0".) Press the "ENTER" key.

(11) The display window now indicates "END X = _". Enter the applicable "X" corresponding to the last "X" on the grid pattern. Press the "ENTER" key.

(12) The display window now indicates "X INCREMENT _". This is the distance between Grid Points in inches in the "X" direction. Press the "ENTER" key.

(13) The display window now indicates "START Y = _". Enter the appropriate "Y" data following the same steps as (9), (10), and (11) above.

(14) After entering the "Y" information above, the screen will show only a "_." It is ready for the first measurement.

7. CALIBRATION VERIFICATION

Calibration shall be verified as stated in Section 3:

(1) Prior to a series of measurements

(2) At approximately 30 minute intervals not to exceed 1 hour

(3) At the completion of a series of measurements

(4) With a change in personnel, power source, or search unit.

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

8. RECALIBRATION

Perform the following if a change of ±0.005 inch from the actual thickness value is noted.

(1) Void all measurements performed after the last valid calibration verification.

(2) Correct the calibration.

(3) Remeasure the voided measurement areas.

9. EXAMINATION

NOTE

The Polycorder must NOT be disconnected from the thickness gauge while data are being taken or the unit is on. Disconnection of the Polycorder may result in the loss of data.

Areas to be examined will be identified by the customer. The entire area of examination will be marked by a grid pattern drawn on the surface of the component with a customer-approved marker. The grid pattern will be as specified by the customer.

Adequate contact may not be possible on pitted surfaces. Where possible, arrangements shall be made with the customer for removal of any surface condition which prevents adequate contact.

(1) Place the search unit on the pipe at the starting X/Y location. Obtain a valid digital display reading. Momentarily press the Send Command Switch to enter the data.

After the first reading is taken, the Polycorder will indicate the "X" and "Y" coordinate location, X=0 and Y=0, and the thickness reading recorded. For each successive data point, the Polycorder will indicate the last coordinate location and the thickness recorded.

(2) Continue taking readings as in (1) by advancing in the scan direction as entered in the Polycorder [see Paragraph 6(9)].

(3) For any location where a measurement cannot be obtained, enter a "0" reading by lifting the transducer from the examination surface (making sure that the couplant doesn't cause a spurious signal) and depressing the Send Command.

(4) Upon reaching the limits of the grid established in the Polycorder, the Polycorder software will display the final recorded thickness measurement and its associated parameters.

(5) After completion of a grid or grid segment, further measurements may be recorded (subject to the memory capacity) by pressing ESC and then proceeding to the polycorder setup step in Paragraph 6(4). The polycorder software is designed to terminate data recording just prior to reaching full capacity, and no further data transmission will be allowed until the Polycorder memory is cleared.

(6) When finished taking measurements, turn the Polycorder off, by depressing the "ESC" and then the "9."

10. EVALUATION

The thickness measurements taken in accordance with this procedure shall be evaluated by the customer or the customer's representative.

11. RECORDS

(1) Data generated in accordance with this procedure will be in the form of computer printouts. Additionally, all computer report files (*.RPT) will be recorded on floppy diskettes for future reference. A copy of each data diskette will also be made available to the customer if so desired. An examination report and location of record storage is at the option of the customer.

(2) The applicable examination record is as follows:

SwRI NDTR Form No.	Revision Date
17-133	03-27-90

SwRI TDAS EXAMINATION AND CALIBRATION SHEET

PROJECT NO.:	SITE:	DATE: (DAY-MONTH-YEAR)	DIRECTORY	SHEET NO.
IDENTIFICATION	COMPONENT		NOMINAL/MINIMUM WALL	TDAS FILE NO.

EXAMINER/LEVEL EXAMINER/LEVEL	COUPLANT: SONOTRACE ☐ GLYCERINE ☐ OTHER (SPECIFY) ______	PROCEDURE NO. REV. DEV.	POLYCORDER NO.

TDAS MK I ☐
SONIC SERIAL NO. ______
INTERFACE SERIAL NO. ______

TDAS MK II ☐
26 DL SERIAL NO. ______

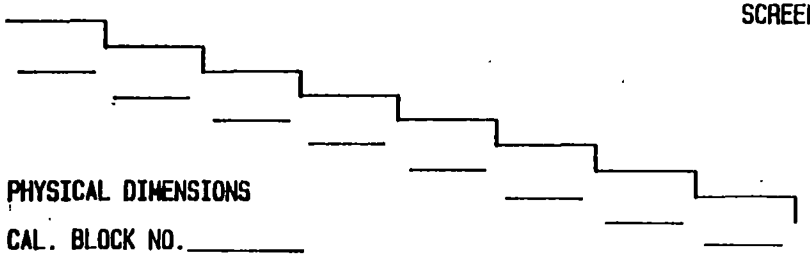
0° SEARCH UNIT	
BRAND	
SERIAL NO.	
SIZE	
NOMINAL FREQUENCY (MHz)	

TEMPERATURE	
PYROMETER NO.	
STEP WEDGE INITIAL	
STEP WEDGE FINAL	
COMPONENT	

CALIBRATION VERIFICATION

TIME:					
INITIALS:					

SCREEN SIZE ______



PHYSICAL DIMENSIONS

CAL. BLOCK NO. ______

MEASURED
ACTUAL

EXAM FILE CODE	X/Y "0" LOCATION	GRID LENGTH "X" "Y"	GRID SPACING

REMARKS:

LIMITATIONS: (IF NONE, SO STATE)

REVIEW BY:	SNT LEVEL	DATE

SwRI Form No. NDTR 17-133 (REV. 03-27-90)

	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	PSE-PT1 Rev. 0, Chg. 0 May 1990 Page 1 of 16

Title SOLVENT-REMOVABLE LIQUID PENETRANT COLOR CONTRAST EXAMINATION

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-16	0	5/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: Alfred R Anderson Date: May 1, 1990

Technical Review: Vic Hutton Date: 15-May 1990

Approved By: David Frank Rosow Date: 5/2/90
Department Director

SwRI Form QA-3A-0

SOLVENT-REMOVABLE LIQUID PENETRANT COLOR CONTRAST EXAMINATION

PSE-PT1

1. PURPOSE AND APPLICATION

(1) This procedure provides the technical information and detailed steps required to ensure proper liquid penetrant examination of nonporous austenitic or carbon steel materials in accordance with the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

(2) The color contrast method of solvent-removable liquid penetrant examination shall be employed as specified in this procedure for detection of surface discontinuities in austenitic or carbon steel material.

(3) Components and welds to be examined are specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1983 Edition with Addenda through Summer 1983, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1983 Edition with Addenda through Summer 1983, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Material/Equipment Certification

(1) The penetrant materials used shall be certified for residual sulfur content and total residual halogens in accordance with SD-129 and SD-808 of Article 24, Section V.

(2) Certified reports for all surface contact materials to be used for penetrant examinations, giving batch numbers and analysis results, shall be obtained from the supplier. Copies of the certified reports shall be retained with the examination records.

(3) Equipment used to measure surface and penetrant container temperature shall have been calibrated and certified, and shall display a valid calibration tag as required by SwRI NPOP 12.0-NDES-102.

4.3 Materials and Equipment

The following materials and equipment shall be used for examinations performed in accordance with this procedure:

(1) Precleaner - Spotcheck, Type SKC-NF or Type SKC-S

(2) Penetrant - Spotcheck, Type SKL-HF/SKL-S or SKL-HF/S

(3) Penetrant Remover - Spotcheck, Type SKC-NF or Type SKC-S

(4) Developer - Spotcheck, Type SKD-NF or Type SKD-S

(5) A thermometer, certified as described in Paragraph 4.2(3).

4.4 Safety Precautions

Safety precautions in accordance with instructions furnished with each manufacturer's penetrant material shall be observed. Highly volatile solvents shall be used cautiously since the vapors may be toxic and the liquids may irritate the skin. Extreme care should be exercised in handling highly flammable solvents.

5. EXAMINATION METHOD

5.1 Surface Condition

(1) Unless otherwise specified by Public Service Electric and Gas Company (PSE&G), all penetrant examinations shall be performed on components in their final surface condition.

(2) The surface to be examined and all adjacent areas within 1 inch shall be dry and free from dirt, grease, lint, scale, welding flux, weld spatter, oil, paint, or any other extraneous matter to the extent that it shall not obscure surface openings or otherwise interfere with the examination.

CAUTION

Blasting with shot or dull sand may peen discontinuities on the surface and shall not be used.

NOTE

Where surface conditions are not in accordance with Subsection 5.1 and correction is not feasible, SwRI will conduct the examination only at the request of PSE&G. The specific surface condition and its probable effect on the examination shall be noted on the SwRI Liquid Penetrant Examination Record.

5.2 Preexamination Cleaning

(1) The surface to be examined and adjacent areas within at least 1 inch shall be thoroughly washed with precleaner in such a manner that foreign material and contaminants are removed.

(2) The examination surface shall then be wiped dry with a lint-free cloth or absorbent paper, allowing a minimum of 5 minutes for complete evaporation.

5.3 Temperature Readings

After preexamination cleaning and before application of penetrant, the temperature of the examination surface and penetrant container shall be measured and recorded on the SwRI Liquid Penetrant Examination Record. The serial number of the thermometer used shall also be recorded.

5.4 Application Penetrant

(1) The penetrant shall be taken from a pressurized container, or bulk container, to ensure its purity. It shall be applied by brushing or spraying and shall evenly cover all areas of the surface being examined.

(2) The allowable minimum and maximum penetrant dwell times shall be as follows:

Component Temperature (°F)	Dwell Time (Minutes)
60-70	20-30
71-90	10-30
91-100	10-20
101-125	10-15

(3) When examinations are to be performed on components whose temperature is below 60°F or above 125°F, this procedure shall be qualified in accordance with the requirements of Section V, Article 6, Subarticle T-647.

(4) The penetrant shall not be allowed to dry. If drying occurs, the penetrant shall be removed and the process repeated, starting with the preexamination cleaning of Subsection 5.2.

5.5 Removal of Excess Penetrant

(1) Initially, the excess penetrant shall be removed by wiping the surface with clean, dry, lint-free cloths or absorbent paper until most traces of excess penetrant have been removed.

(2) A clean, dry, lint-free cloth or absorbent paper shall then be moistened with penetrant remove, and the surface shall be wiped lightly until all remaining traces of excess penetrant have been removed. Extreme care shall be employed to avoid the use of an excessive amount of remover in order to preclude the removal of penetrant from discontinuities.

(3) The surface shall not be flushed nor receive direct application of remover prior to the application of the developer.

5.6 Drying

The surface shall be completely dry prior to application of the developer.

5.7 Application of Developer

(1) The developer shall be applied as soon as possible after penetrant removal. The maximum time interval between penetrant removal and developer application shall not exceed 30 minutes.

(2) After sufficient agitation of the pressurized container to ensure that the particles in suspension are dispersed, a smooth, uniform layer shall be sprayed onto the surface.

(3) The developer shall be used sparingly. The proper developer thickness will dry to a thin, translucent layer. If the coating is too thick, it may mask indications. The examination surface shall be observed during the application of the developer to monitor the behavior of indications which tend to bleed-out profusely.

(4) Final interpretation of indications shall be made a minimum of 7 minutes to a maximum of 30 minutes after the developer has been applied.

6. EXAMINATION

6.1 Examination Areas

(1) The examination area for Class 1 and 2 longitudinal and circumferential welds shall be the weld and adjacent base material for a distance of 1/2 inch on each side of the weld as shown in Figure 1.

(2) 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.

(3) 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.

(4) The examination area for Class 2 branch connections shall be the weld and 1/2 inch of base material on each side of the weld fusion line, and for Class 1 branch connections the examination area shall be as shown in Figure 2.

EXCEPTION

If the Class 2 branch connection is a set-in type, the examination area shall be the weld, 1/2 inch of base material on the main run pipe side from the weld fusion line, and the base material on the branch pipe side from the weld fusion line to the end of the radius section.

(5) The examination area for Class 1 and 2 support attachments, integral attachment welds, and support circumferential weld joints shall be the weld and 1/2 inch of base material on each side of the weld fusion line as shown in Figure 3 or Figure 4, as applicable.

(6) The examination area for Class 1 socket welds in piping shall be the weld, 1/2 inch of base material on the pipe side, and 1.0 inch of base material on the fitting side as shown in Figure 1.

(7) The examination area for control rod drive housing welds shall be as shown in Figure 5.

(8) The examination areas for vessel head-to-flange weld joints shall be as shown in Figure 4.

(9) The examination areas for Class 2 nozzles shall be as shown in Figure 6.

6.2 Examination Methods

(1) Examinations shall be performed by placing the eye within 24 inches of the surface to be examined and at an angle no less than 30 degrees with the surface to be examined. A mirror may be used to improve the angle. In addition to general lighting, additional illumination of the examination area shall be provided at right and oblique angles to expose indications. The illumination shall be adequate to ensure no loss of sensitivity.

(2) If the examination surface is sufficiently large to preclude complete examination within the prescribed times, the surface shall be examined in suitable increments.

6.3 Postexamination Cleaning

(1) The developer and penetrant shall be removed by wiping the surface thoroughly with cloths saturated with a suitable solvent. Spraying directly on the examination areas with pressurized containers shall be allowed for postexamination cleaning.

(2) The surface shall then be wiped dry with clean, lint-free cloths or absorbent paper.

6.4 Reexamination

Indications that are believed to be nonrelevant shall be reexamined to verify whether actual defects are present. Surface conditioning may precede the reexamination. Nonrelevant indications and broad areas of pigmentation that would mask indications are unacceptable.

> **NOTE**
>
> Indications that are obviously nonrelevant such as stamp marks or radiograph punch marks shall only be recorded as a general remark on the SwRI Liquid Penetrant Examination Record.

7. RECORDING AND REPORTING CRITERIA

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI NPOP SwRI-NDE2.

7.1 Examination Areas/Recording Criteria in Accordance with Section XI

The indication recording criteria shown below apply to the following areas:

(1) Reactor vessel head-to-flange welds,

(2) Class 1 and 2 similar and dissimilar metal welds in piping,

(3) Class 1 valve body welds 2 inches or greater but less than 4 inches in thickness,

(4) Class 2 pump casing and valve body welds 2 inches or greater in thickness, and

(5) Control rod housing welds less than 2.5 inches in thickness.

Indication Recording Criteria

Nominal Wall Thickness (Inches)	Overall Indication Length* (Inches)
Less then 1.0	≥1/8
1.0 to less than 2.5	≥3/16
2.5 and greater	≥1/4

*Length (ℓ) as defined in Figure 7. Only the greatest dimension of the indication shall be considered. This section makes no distinction between linear and rounded indications.

NOTE

For preservice examinations, indications with a length of 1/16 inch in ferritic piping with less than 0.312 inch in nominal wall thickness shall be recorded.

7.2 Limitations

When conditions limit the area of examination, the limitations shall be recorded.

7.3 Reporting

Any indications recorded in accordance with the requirements of this procedure shall be reported to PSE&G.

8. EVALUATION

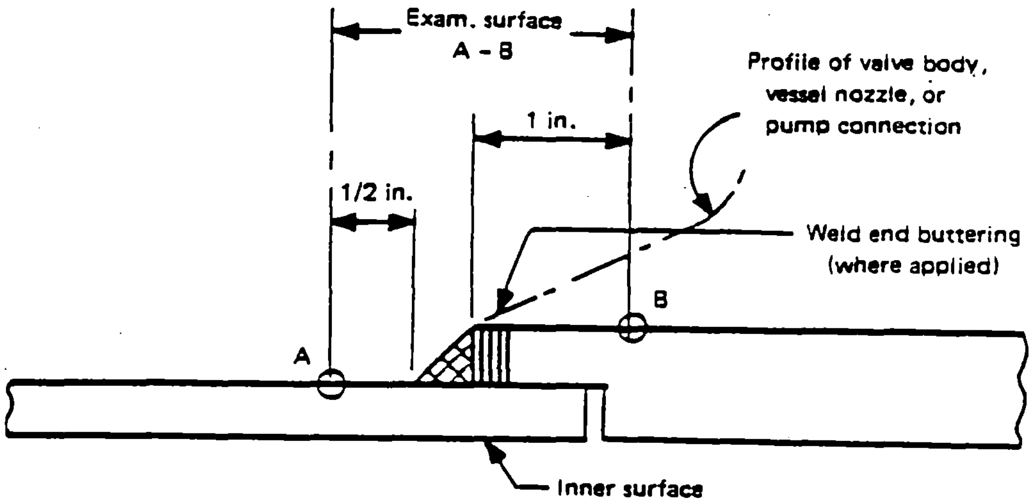
Initial evaluation of reportable indications shall be performed by SwRI personnel, and shall be conducted in accordance with the applicable ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-3000. Final evaluation and disposition of reportable indications shall be the responsibility of PSE&G.

9. RECORDS

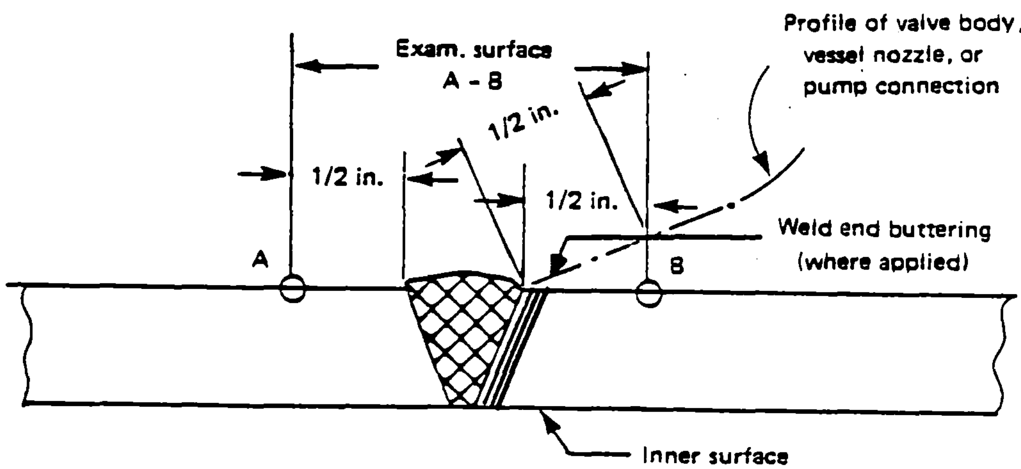
(1) Documents generated in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G. PSE&G shall receive copies of these documents in the Final Report, unless specified otherwise in the SwRI Examination Plan.

(2) The applicable examination record is as follows:

SwRI-NDTR Form No.	Revision Date
17-11	1-3-79



(a) Socket Welded Piping



(b) NPS < 4 in.

Figure 1. Similar and dissimilar metal welds in components and piping

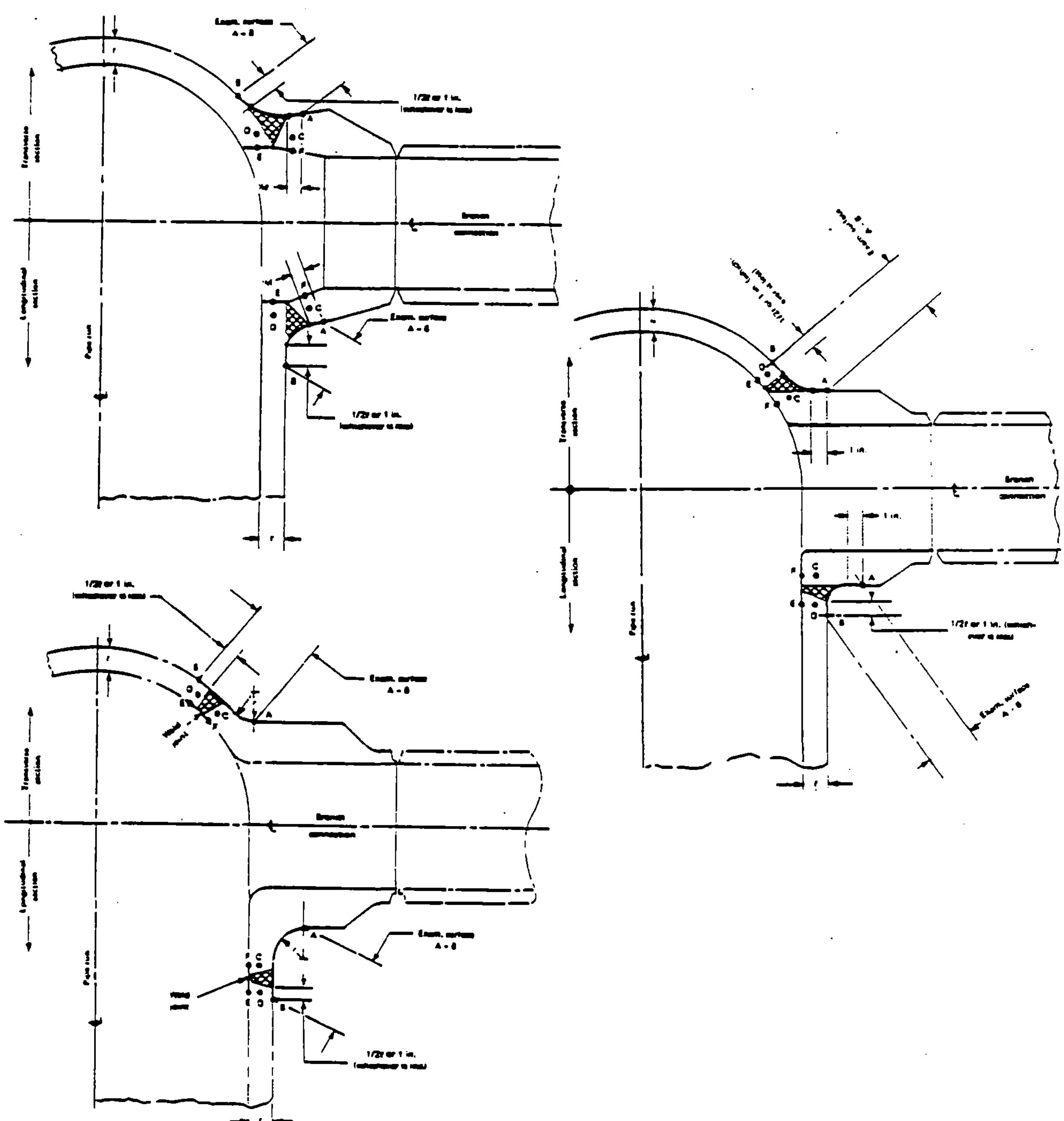
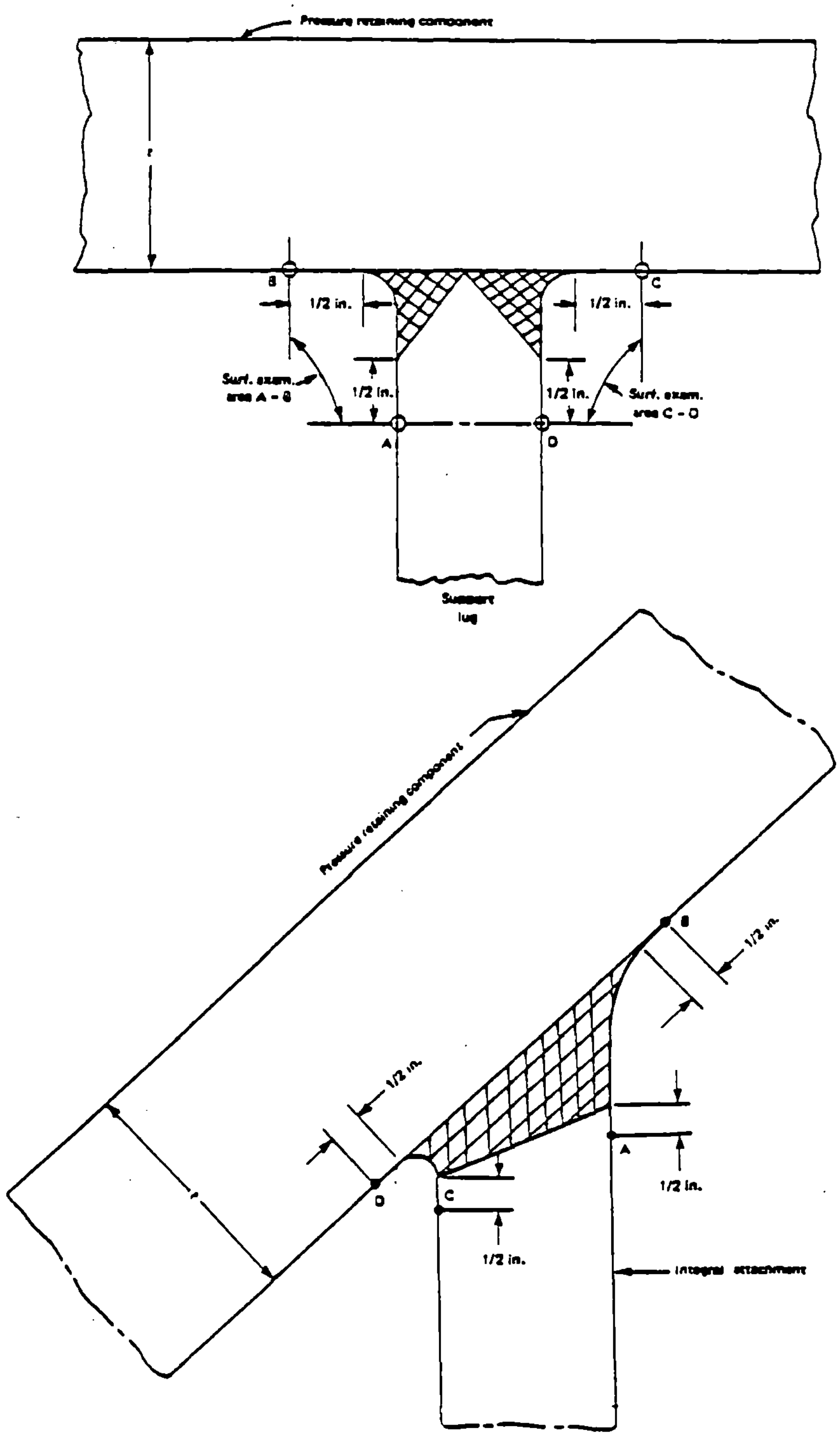
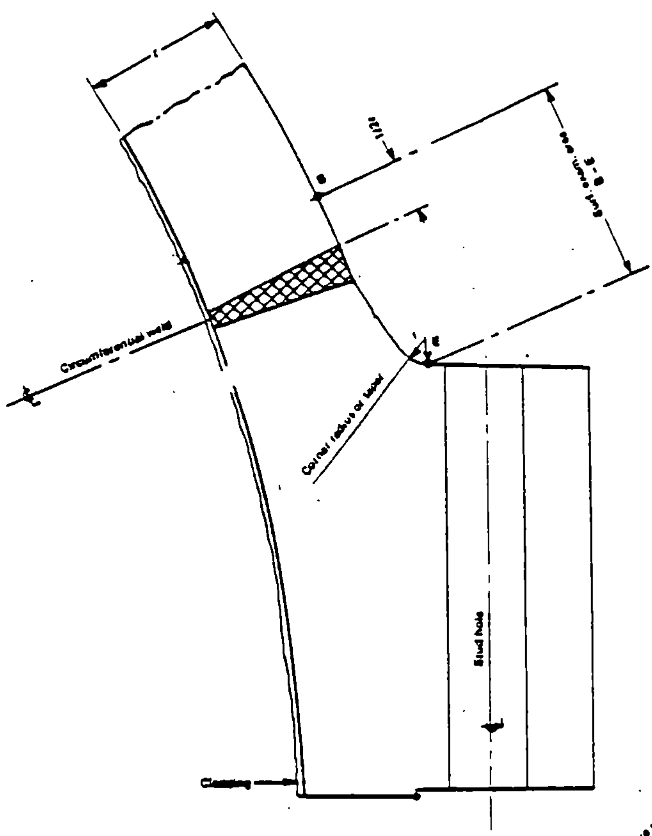


Figure 2. Class 1 branch connection welds
(Surface examination requirements)

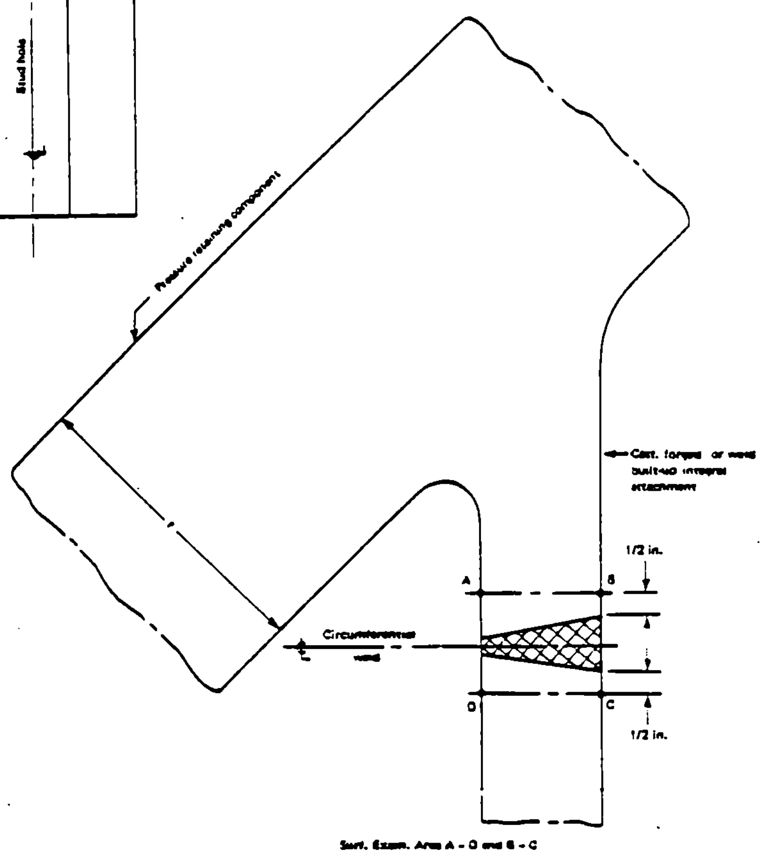


Surface examination areas: A-B and C-D for Class 1 components; A-B for Class 2 components

Figure 3. Surface examination areas



Head-to-Flange Weld Joint



Support Circumferential Weld Joint

Figure 4. Support circumferential weld joint

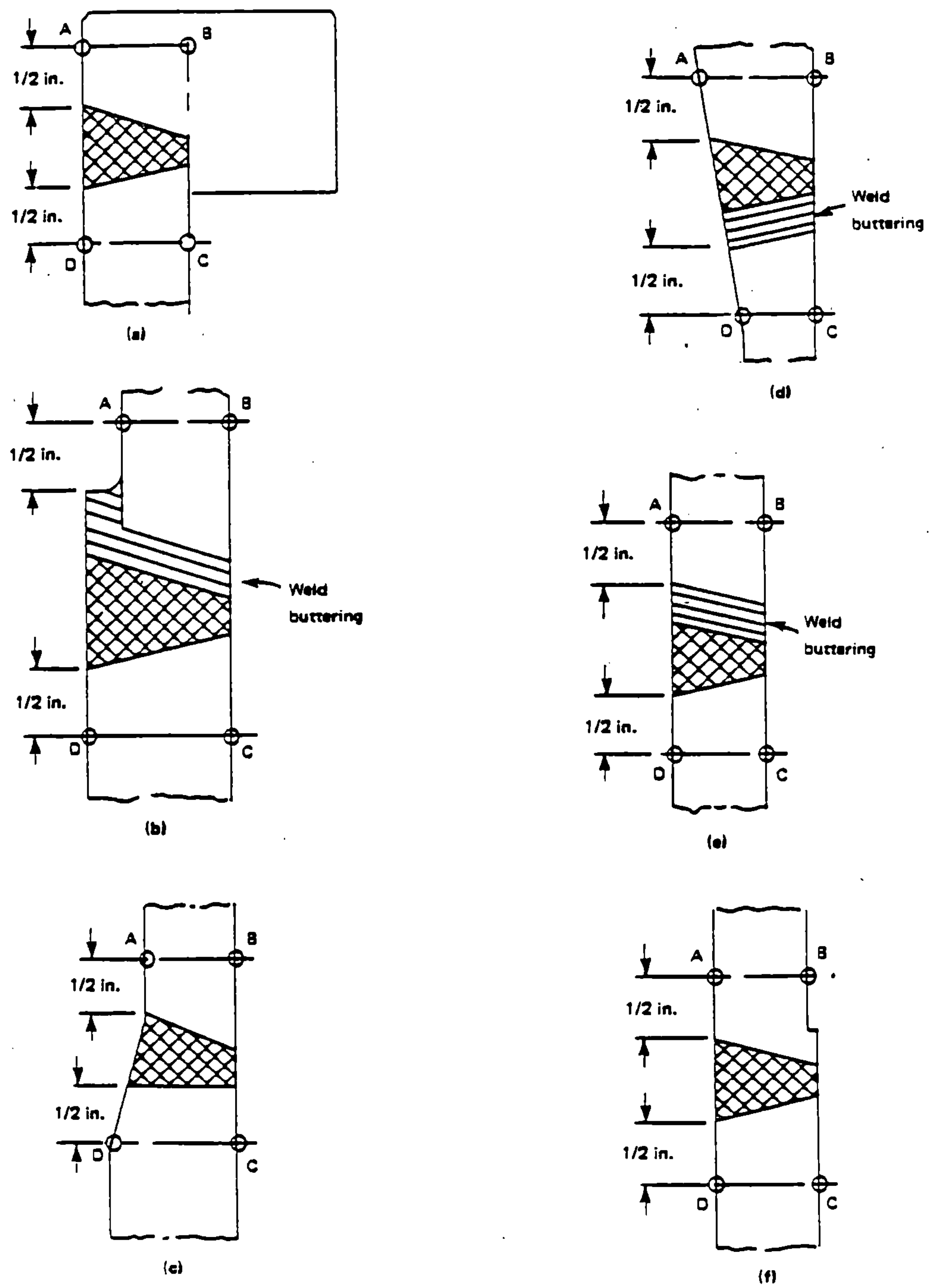


Figure 5. Control rod drive housing welds

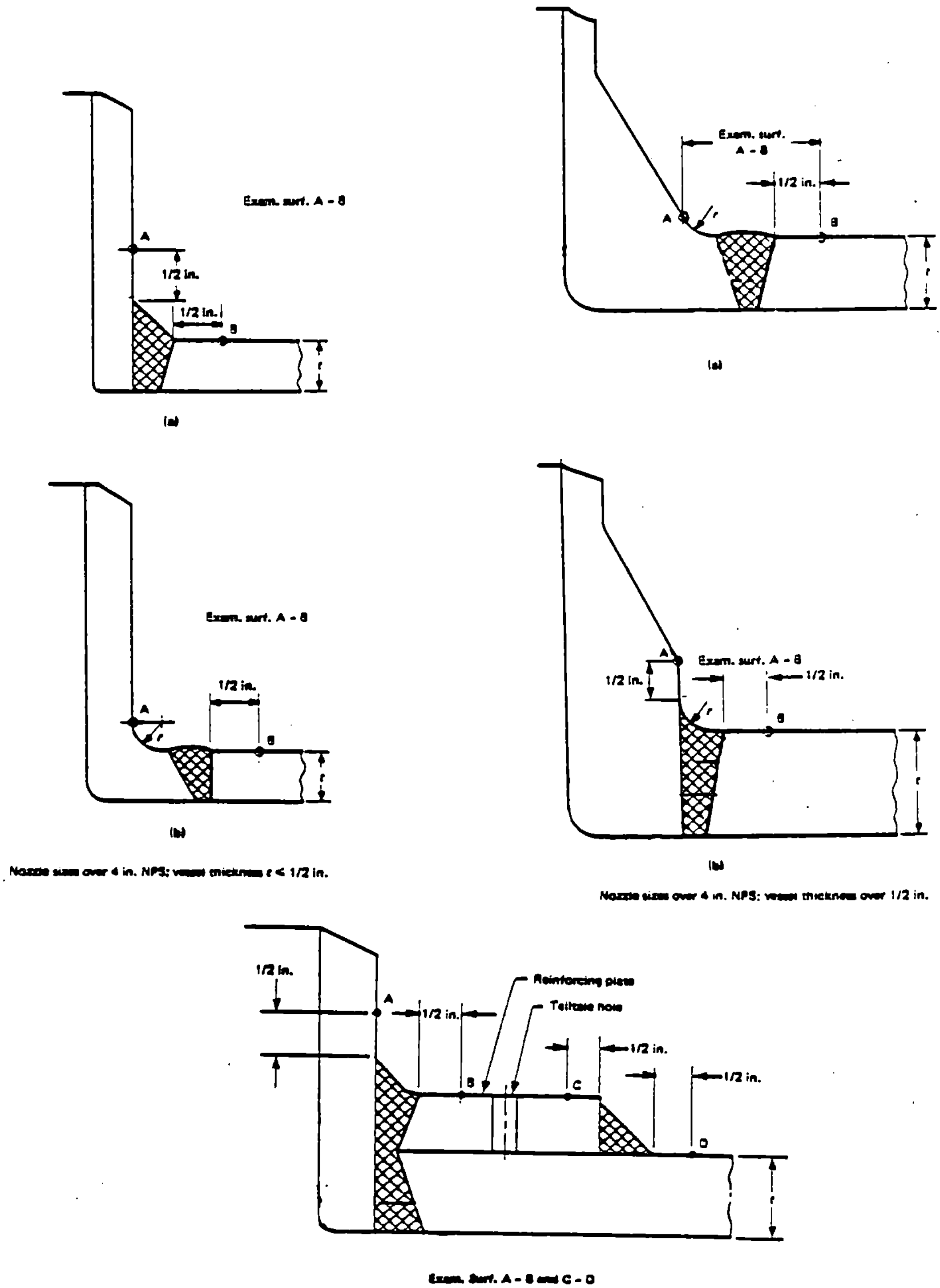


Figure 6. Requirements for Class 2 nozzle-to-vessel welds

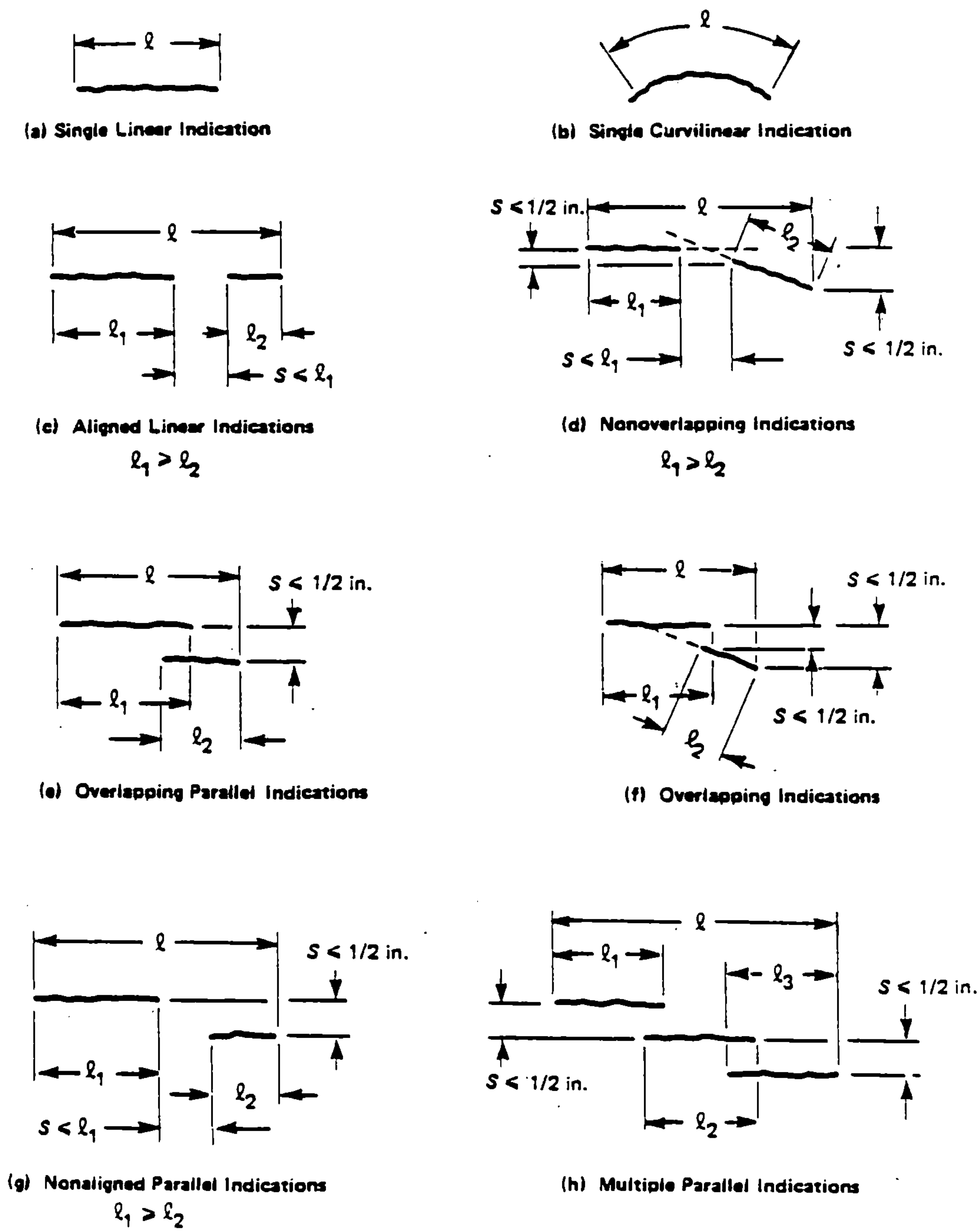


Figure 7. Linear surface indications illustrative flaw configurations and determination of length ℓ

S R I	SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE	SAM2-VT1 Rev. 0, Chg. 0 February 1990 Page 1 of 6

Title

VISUAL EXAMINATION OF NUCLEAR POWER PLANT COMPONENTS BY DIRECT OR REMOTE VIEWING

EFFECTIVITY AND APPROVAL

Page	Change	Date
1-6	0	2/90

Supersedes Previous Revision/Changes? ☒ Yes ☐ No

Prepared By: John C. Zyamello Date: 2/6/90

Technical Review: Paul A. Hodin Date: 21 FEB 90

Approved By: David Frank Rosow Date: 2/26/90
Department Director

SwRI Form QA-3A-0

VISUAL EXAMINATION OF NUCLEAR POWER PLANT COMPONENTS BY DIRECT OR REMOTE VIEWING

SAM2-VT1

1. PURPOSE AND APPLICATION

(1) This procedure provides the methods for performing visual (VT) examination of nuclear power plant components.

(2) Direct and remote VT techniques for the examination of nuclear power plant components are described in this procedure. Components and welds to be examined are specified in the applicable Southwest Research Institute (SwRI) Examination Plan.

2. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition with Addenda through Summer 1975, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1974 Edition with Addenda through Summer 1975, "Nondestructive Examination"

(3) SwRI Nuclear Quality Assurance Program Manual

3. RESPONSIBILITY

(1) The Director of the Department of NDE Services shall be responsible for the approval of this procedure.

(2) The Project Manager shall be responsible for the application of this procedure.

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

4. PERSONNEL AND EQUIPMENT

4.1 Personnel Certification

Personnel performing examinations shall be certified in accordance with SwRI Nuclear Projects Operating Procedure (NPOP) 2.0-NDES-101, "Nondestructive Examination Personnel Qualification and Certification."

4.2 Equipment

(1) The Visual Examination Acceptability Test Card shall be made from Kodak Neutral Test Card No. R-27, or an equivalent with an 18% neutral grey side having a 1/32-inch wide black line across its center.

(2) Commercially available equipment shall be used as required for the performance of examinations by the techniques described in Subsections 5.2 and 5.3.

5. EXAMINATION METHOD

5.1 Surface Condition

(1) VT examinations that require clean surfaces or decontamination for valid interpretation of results shall be preceded by appropriate cleaning processes.

(2) The surface of welds and adjacent base material to be examined shall be free from scale, slag, dirt, paints, or other extraneous matter that obscures the surface or interferes with the VT examination.

(3) Examinations on components with painted or coated surfaces are permitted when looking for general conditions such as misalignment, movement, or other abnormalities on supports, hangers, snubbers, and shock observers, or loose, missing and damaged bolting.

(4) The examiner shall determine the condition of the part, component, or surface with respect to indications such as, but not limited to cracks, wear, corrosion/erosion, or physical damage to the surface of the component.

5.2 Direct Visual Technique

Direct VT examination shall be performed by placing the eye within 24 inches of and at an angle no less than 30 degrees to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as magnifying lenses may also be used.

5.2.1 Lighting

In addition to the general lighting, illumination of the area to be examined shall be provided at right angles and oblique angles to expose cracks or evidence of corrosion/erosion.

5.2.2 Resolution

Resolution shall be considered adequate when the combination of access, lighting, and angles of vision, either unaided or corrected, can resolve a black line, 1/32-inch wide, on the 18% neutral grey card described in Subsection 4.2, when it is placed on the surface to be examined.

5.3 Remote Visual Technique

(1) Remote VT examination may be used when conditions exist that do not permit direct VT examination. Remote VT examination may include visual aids such as telescopes, periscopes, borescopes, fiber optics, or video cameras and monitoring systems, with or without attachments for permanent recording. Remote techniques shall demonstrate the ability to provide a resolution at least equivalent to that

obtainable by direct VT examination. Mirrors, movable lights, or rotating optics, or any combination thereof, may be employed to display cracks, surface scratches, or evidence of corrosion/erosion, misalignment, or movement.

(2) Resolution for remote VT technique shall be acceptable provided the surface resolution is at least equivalent to that considered obtainable by direct VT technique.

5.4 Replication

Surface replication techniques shall be considered acceptable provided the surface resolution is at least equivalent to that obtainable by VT technique.

6. EXAMINATION AREAS

(1) Components, parts, and areas to be examined shall be as specified in the applicable SwRI Examination Plan. Remote VT examinations utilizing automated scanning devices shall be as specified in the applicable SwRI Scan Plan. Scanning parameters, if required, for the remote VT examination shall be included in the applicable SwRI Scan Plan.

(2) The examination area of welds shall include the weld and the adjacent base material for at least one wall thickness beyond the edge of the weld.

(3) VT examination of the flange surfaces of vessels, pumps, valves, and piping, when the connection is disassembled, shall include 1.0 inch annular surface of flange surrounding each stud hole.

7. RECORDING AND REPORTING CRITERIA

(1) Indications shall be recorded, where applicable, in accordance with the techniques outlined in the latest revision of SwRI NPOP SwRI-NDE2 for direct VT examinations.

(2) VT indications detected during remote examinations shall be recorded in accordance with Public Service Electric and Gas Company's (PSE&G) specifications, remote equipment manufacturer's specifications, or the SwRI Scan Plan, if applicable.

(3) VT abnormalities shall be recorded on the SwRI Visual Examination Record and reported to PSE&G. Abnormalities shall include scratches, wear, cracks, or corrosion/erosion on the surface, evidence of leaking, misalignment, and relative movement of the part or component, or other degradation to the general condition of the component.

7.1 Pressure-Retaining Bolting

(1) Crack-like linear surface indications that exceed the following limits shall be recorded and reported to the PSE&G:

(a) nonaxial indications, 1/8 inch in length

(b) axial indications, 1/2 inch in length

(2) The following conditions shall also be recorded and reported to PSE&G:

(a) deformed or sheared threads in the zone of thread engagement of bolts, studs, or nuts

(b) localized general corrosion that reduces the bolt's or stud's cross-sectional area

(c) bending, twisting, or deformation of bolts or studs

(d) missing or loose bolts, studs, nuts, or washers

(e) fractured bolts, studs, or nuts

(f) degradation of protective coatings on bolting surfaces

(g) evidence of coolant leakage near bolting

7.2 Pump Casing and Valve Bodies

The following conditions shall be recorded and reported to PSE&G:

(1) corrosion/erosion that reduces the pressure-retaining wall thickness

(2) wear of mating surfaces

(3) crack-like surface indications that exceed 1/16 inch

7.3 Interior Attachment-to-Vessel Welds

The following indications shall be recorded and reported to PSE&G:

(1) crack-like linear surface indications on the welds joining the attachment to the vessel wall that exceed 3/8 inch in length

(2) structural degradation of attachment welds

8. EVALUATION

Evaluation of reportable indications shall be the responsibility of PSE&G and shall be conducted in accordance with Article IWA-3000, Section XI, of the applicable ASME Boiler and Pressure Vessel Code.

9. RECORDS

(1) Records produced in accordance with this procedure shall be stored in the Division 17 Records Vault, or as specified by PSE&G.

(2) The applicable data records are as follows:

SwRI NDTR Form No.	Revision Date
17-28	7-31-75

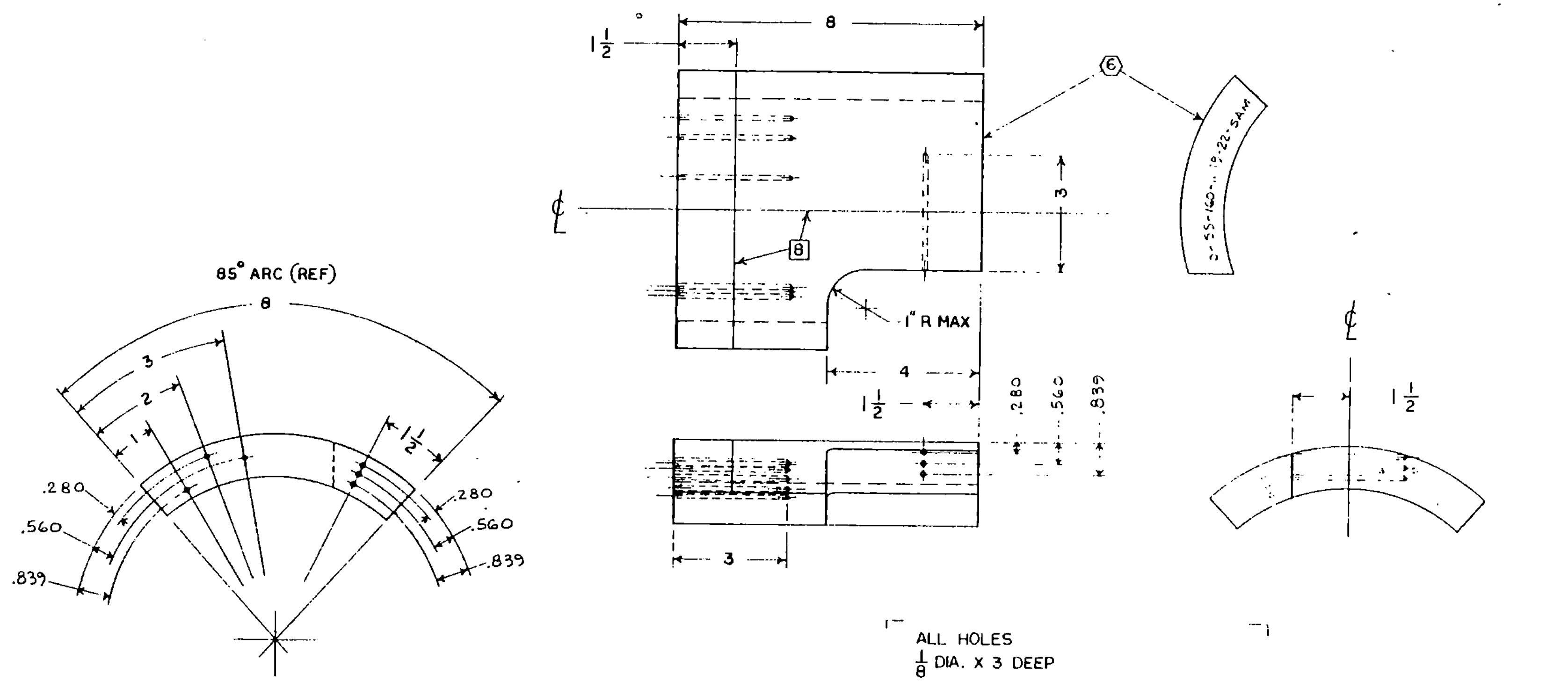
APPENDIX D

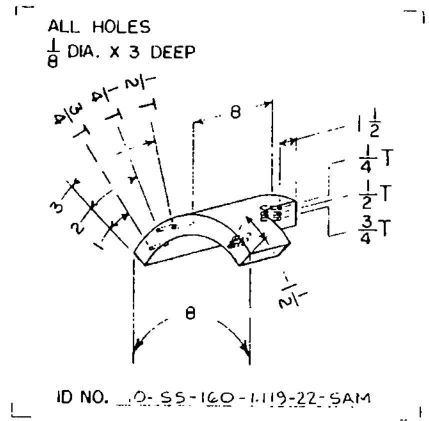
CALIBRATION BLOCK DRAWINGS

APPENDIX D

CALIBRATION BLOCK DRAWINGS

Table of Contents





NOTES.

1. DIMENSIONS ARE IN INCHES.
2. DEBURR & BREAK SHARP EDGES 1/64.
3. DO NOT MACHINE OR ALTER ID OR OD SURFACES.
4. ID AND OD SURFACES TO BE FREE OF TOOL MARKS.
5. MATERIAL FOR STANDARD TO BE FREE OF:
   PIPE SEAM WELDS,
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
6. STEEL STAMP STANDARD ID NO. AS SHOWN, ON SURFACE INDICATED, IN CHARACTERS 3/16" MIN. HEIGHT.
7. ALL HOLES ARE 1/8" DIA. BREAKING THROUGH OF DRILL POINT IS ACCEPTABLE.
8. SCRIBE 2 CENTERLINES AS SHOWN .003 TO .010 WIDE & DEEP.
9. 10" SCH. 160 SS PIPE SUPPLIED BY P.S.E.& G. CO. HEAT # 55425

LET	CHANGE	DATE	CHK	APP
A	INCORPORATED DCN 491	9/4/75	JA	[illegible]

REVISIONS

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PARTS LIST

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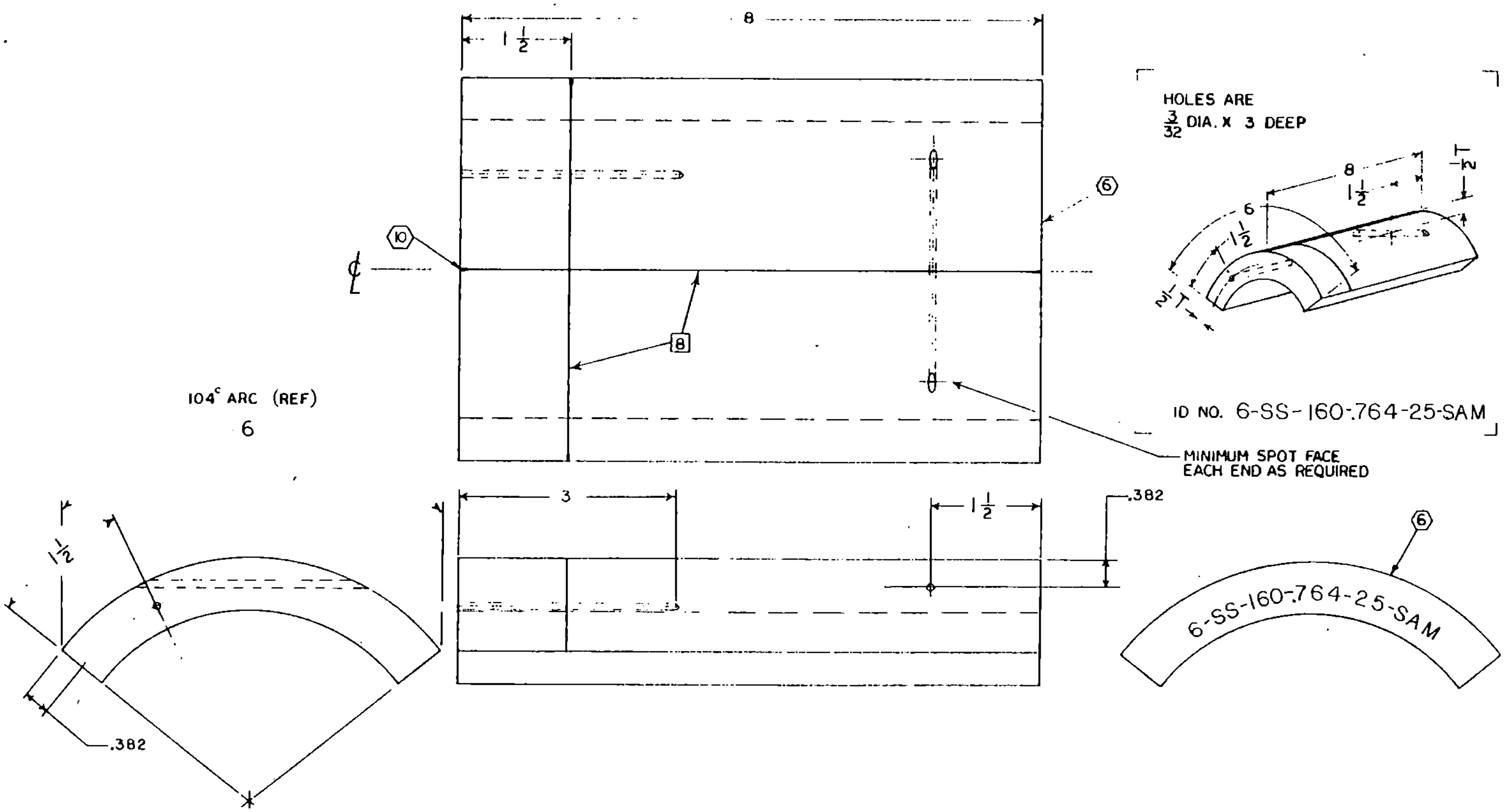
DESIGNED BY J. CRANE	MATERIAL SEE P/L		
CHECKED BY JJC	HEAT TREAT ~	SOUTHWEST RESEARCH INSTITUTE SAN ANTONIO, TEXAS	DATE 3-21-75 SCALE 1/2
APPROVED BY NJ	FINISH 125		DRAWING NUMBER C-3052022A

SK. 145



NOTES:

1. DIMENSIONS ARE IN INCHES.
2. DEBURR & BREAK SHARP EDGES 1/64.
3. DO NOT MACHINE OR ALTER ID OR OD SURFACES.
4. ID AND OD SURFACES TO BE FREE OF TOOL MARKS.
5. MATERIAL FOR STANDARD TO BE FREE OF:
   PIPE SEAM WELDS,
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT
   ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
6. STEEL STAMP STANDARD ID NO. AS SHOWN, ON SURFACE INDICATED, IN CHARACTERS 3/16" MIN HEIGHT.
7. ALL HOLES ARE 3/32" DIA.
8. SCRIBE 2 CENTERLINES AS SHOWN .003 TO .010 WIDE & DEEP.
9. MAKE FROM 6" SCHEDULE 160 TYPE 316 STAINLESS STEEL PIPE. SUPPLIED BY PSE and G. HEAT № B-1960.
10. STEEL STAMP SCRIBE LINE REFERENCE MARKS AS SHOWN.

9

DASH NO	NO REQ'D	PART NAME	MATERIAL
		PIPE STANDARD	6" SCH 160 PIPE

PARTS LIST

LET	CHANGE	DATE	BY	APP

REVISIONS

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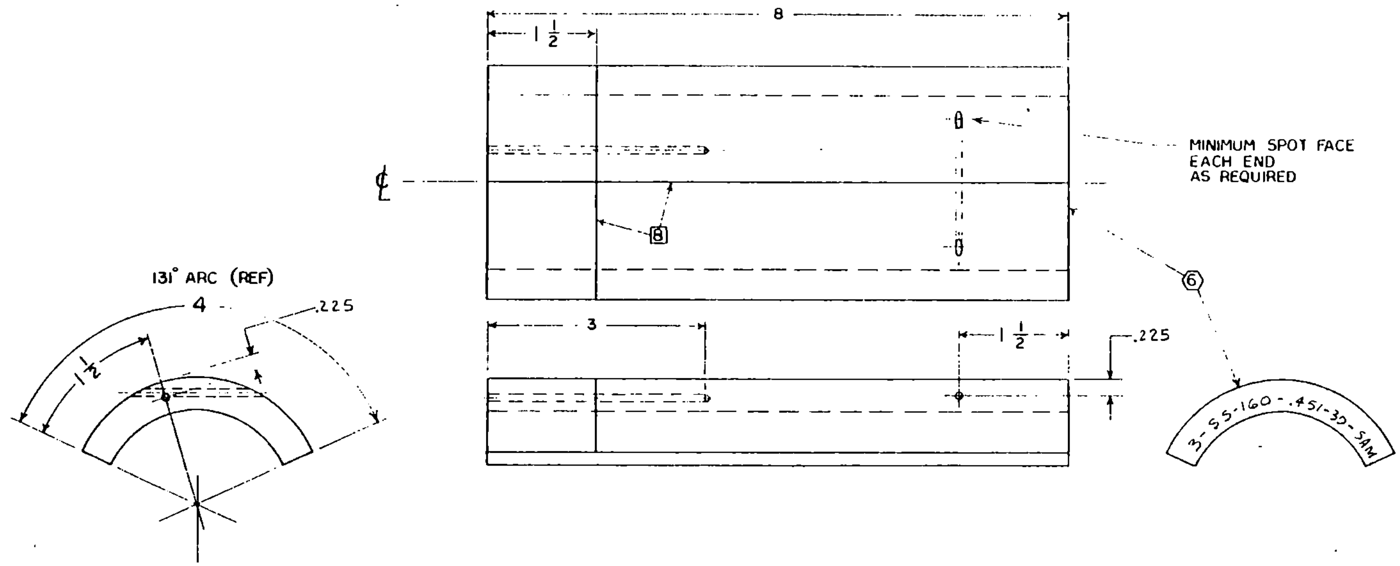
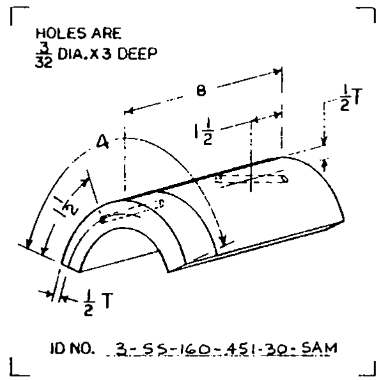
DESIGNED BY J. CRANE	MATERIAL SEE P/L		
CHECKED BY JTC	HEAT TREAT ~	SOUTHWEST RESEARCH INSTITUTE SAN ANTONIO, TEXAS	DATE 6-23-75 SCALE 1/1
APPROVED BY W. Clayton	FINISH 125		DRAWING NUMBER C3052034





NOTES:

1. DIMENSIONS ARE INCHES.
2. DEBURR & BREAK SHARP EDGES 1/64.
3. DO NOT MACHINE OR ALTER ID OR OD SURFACES.
4. ID & OD SURFACES TO BE FREE OF TOOL MARKS.
5. MATERIAL FOR STANDARD MUST BE FREE OF:
   PIPE SEAM WELDS,
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT
   ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
6. STEEL STAMP STANDARD ID NO. AS SHOWN, ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN HEIGHT.
7. HOLES ARE 3/32"DIA.
8. SCRIBE 2 CENTERLINES AS SHOWN .003 TO .010 WIDE & DEEP.
9. 3" SCH. 160 S.S. PIPE SUPPLIED BY P.S.E. & G. CO. HEAT M4564

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9		PIPE STANDARD	3" SCH 160 PIPE

PARTS LIST

LET.	CHANGE	DATE	BY	APP.

REVISIONS

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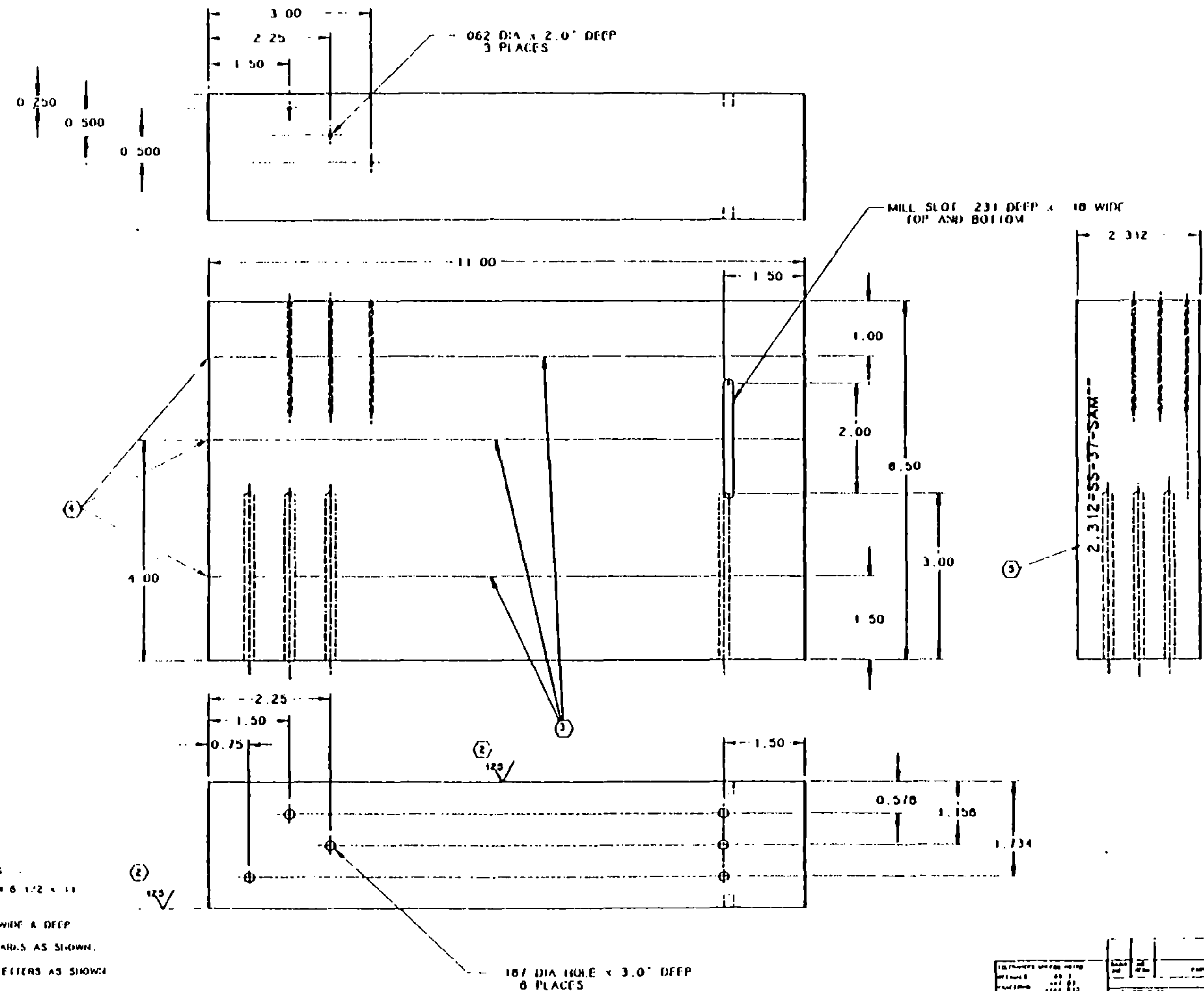
DESIGNED BY J. CRANE	MATERIAL SEE P/L		
CHECKED BY	HEAT TREAT	SOUTHWEST RESEARCH INSTITUTE SAN ANTONIO, TEXAS	DATE 3-21-75 SCALE 1/1
APPROVED BY	FINISH 125		DRAWING NUMBER C-30520[illegible]



2.312-SS-37-SAM

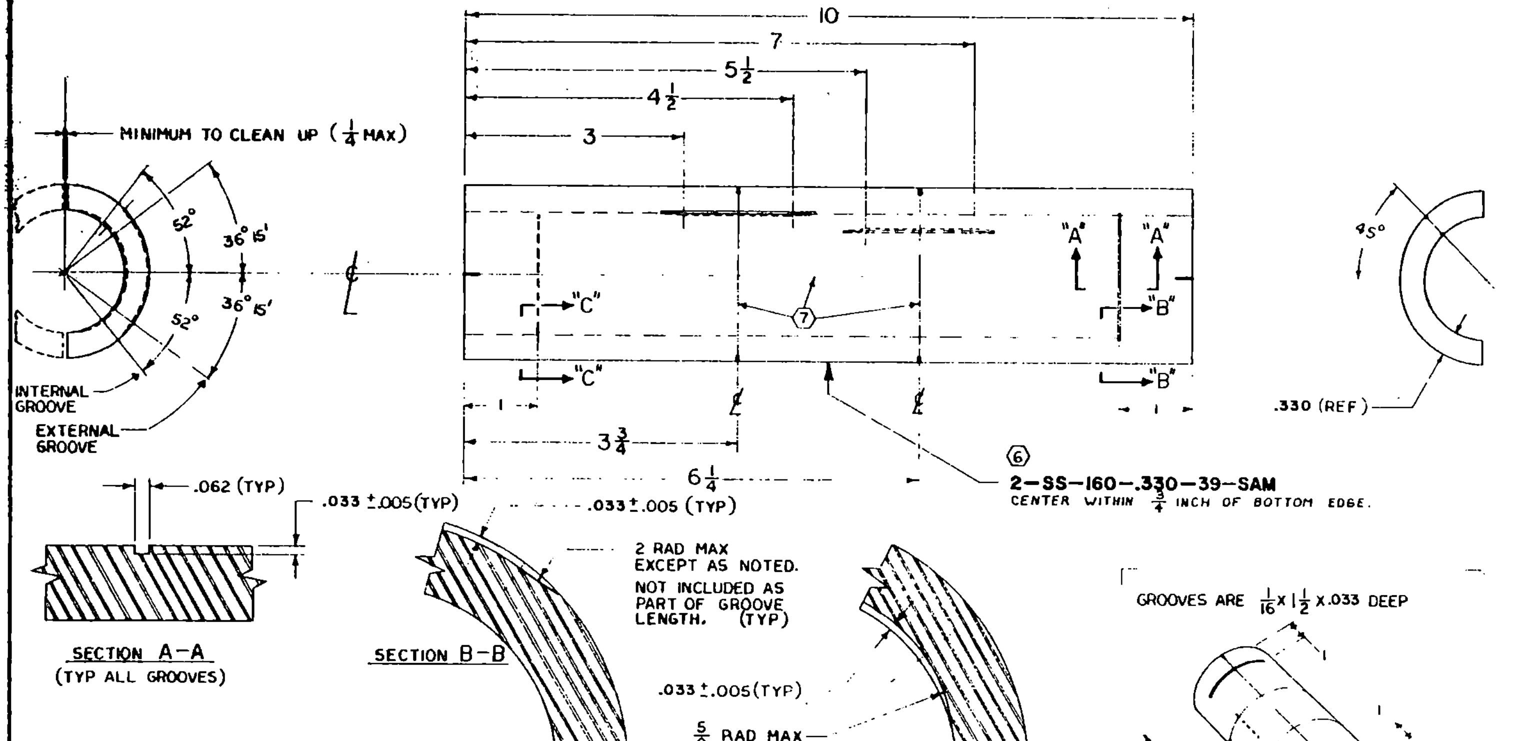
NOTES:

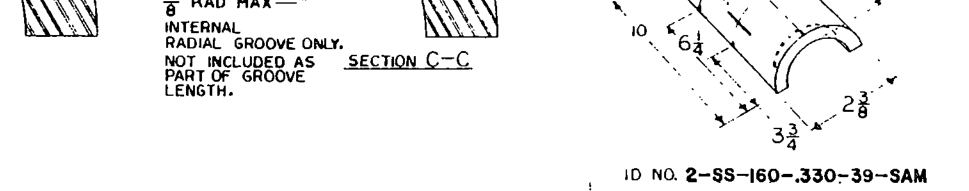
1. REMOVE BURRS AND BREAK SHARP EDGES.
(2) ROUGH SURFACE GRIND TOP AND BOTTOM 6 1/2 x 11 SURFACES TO A 125/ SURFACE FINISH.
(3) SCRIBE LINE AS SHOWN .003 TO .005 WIDE & DEEP.
(4) STEEL STAMP SCRIBE LINE REFERENCE MARKS AS SHOWN.
(5) STEEL STAMP I.D. NO. 3/16" HEIGHT LETTERS AS SHOWN.
(6) MAKE FROM 2 5/8 x 7 x 15 TYPE 316 FORGING SUPPLIED BY P.S.E. & G. HEAT NO. 819102

SOUTHWEST RESEARCH INSTITUTE

2 5/16" PLATE STANDARD
2.312-SS-37-SAM

1:1 | C | D-3052-039 | B





NOTES:

1. DIMENSIONS ARE IN INCHES.
2. DEBURR & BREAK SHARP EDGES.
3. DO NOT MACHINE OR ALTER ID OR OD SURFACES.
4. ID & OD SURFACES TO BE FREE OF TOOL MARKS.
5. MATERIAL FOR STANDARD TO BE FREE OF:
   PIPE SEAM WELDS,
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
6. STEEL STAMP ID NO. AS SHOWN, ON SURFACE INDICATED & WITHIN LIMITS OF AREA NOTED, IN CHARACTERS 3/16" MINIMUM HEIGHT.
7. SCRIBE CENTERLINES .003 TO .005 WIDE & DEEP WHERE NOTED. STEEL STAMP, OR MILL CUT, AN INDEX MARK AT EACH END OF CENTERLINES AS SHOWN, 1/32 WIDE & DEEP x 1/4 LONG.
8. MAKE FROM 2" SCHEDULE 160 A376 TYPE 316 SS PIPE SUPPLIED BY PSE AND G HEAT No. 49769

LET	CHANGE	CHK	DATE	APP	APP
A	INCORP DCN-702	JA	29 JAN 76		

REVISIONS

DASH NO	NO REQ'D	PART NAME	FDR -30-76 MATERIAL

PARTS LIST

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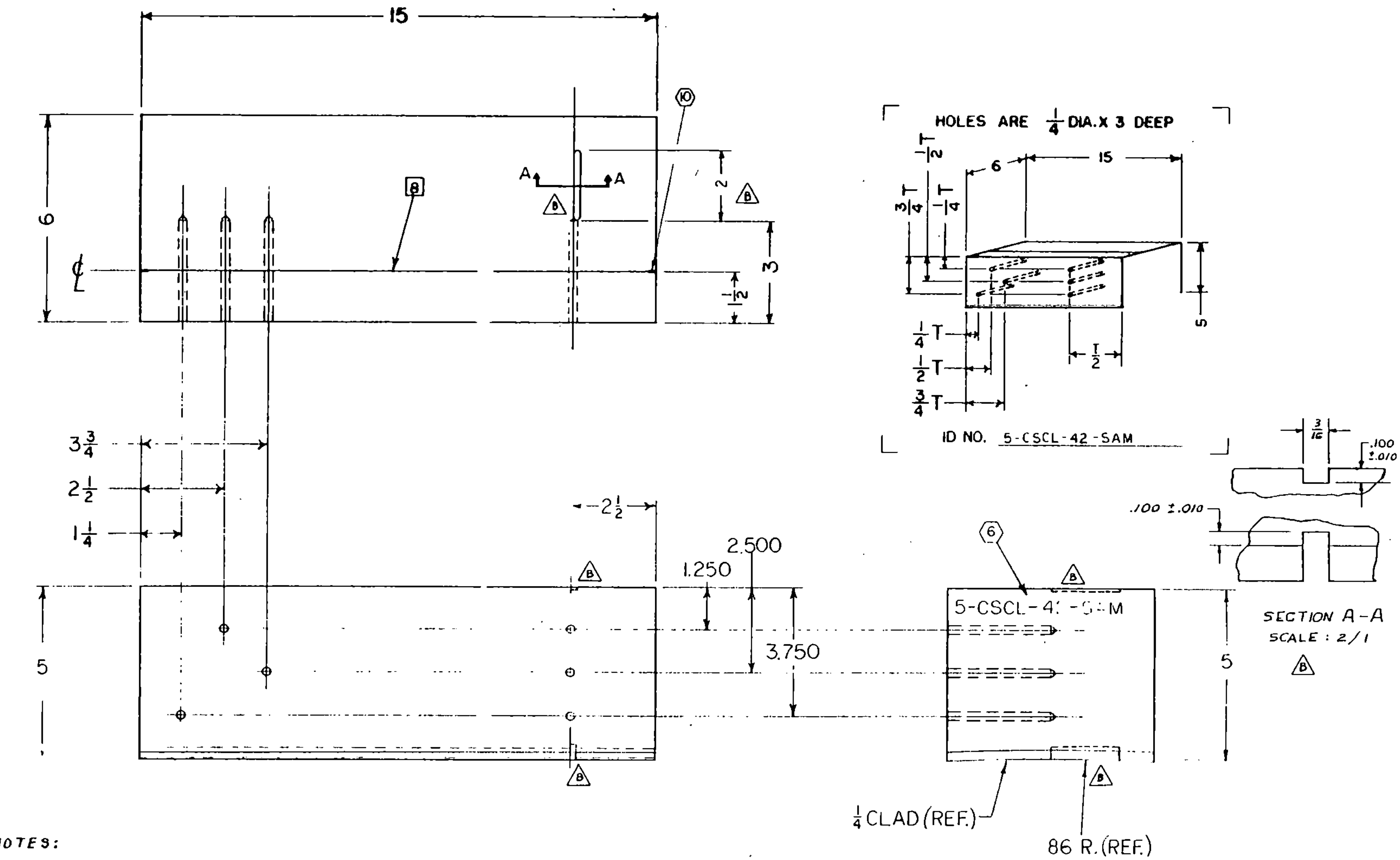
DESIGNED BY J. CRANE	MATERIAL 8		
CHECKED BY JTC	HEAT TREAT ~	SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO, TEXAS	DATE 7-21-75 SCALE 1/1
APPROVED BY	FINISH 125	C I	DRAWING NUMBER C-3052 048 A



NOTES:

1. DIMENSIONS ARE IN INCHES.
2. DEBURR & BREAK SHARP EDGES 1/64.
3. DO NOT MACHINE OR ALTER 6 x 15 TOP OR BOTTOM SURFACES.
4. TOP & BOTTOM 6 x 15 SURFACES TO BE FREE OF TOOL MARKS.
5. MATERIAL FOR STANDARD TO BE FREE OF:
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT
   ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
6. STEEL STAMP STANDARD ID NO. AS SHOWN, ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.
7. ALL HOLES ARE 1/4 DIA. x 3 DEEP.
8. SCRIBE CENTERLINE AS SHOWN .003 TO [illegible] WIDE & DEEP.
9. MAKE FROM SA 302 B DROP OUT MATERIAL SUPPLIED BY PSE & G HEAT Nº A-0497.
10. STEEL STAMP SCRIBE LINE REF MARKS 1/32 WIDE x 1/32 DEEP 1/4 LONG AS SHOWN.

LET	CHANGE		DATE	CK	APP
B	UCORP DCN - 1913	[illegible]	10/4/77	[illegible]	[illegible]
A	INC DCN #582	[illegible]	10/30/75	[illegible]	[illegible]

REVISIONS ⑨

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			FDR IC 6-77

PARTS LIST

DRAWN BY TOM D. J.A.	NO REQ'D
DESIGNED BY J. CRANE	MATERIAL SEE P/L
CHECKED BY [illegible]	HEAT TREAT ~
APPROVED BY	FINISH 125

TOLERANCES UNLESS NOTED: DECIMALS ± [illegible]; FRACTIONS ± [illegible]; ANGLES ± 1/2°

5" CLAD PLATE U.T CALIBRATION STD. SALEM

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO TEXAS

DATE 10-21-75 | SCALE 1/2

DRAWING NUMBER C-3052058 B

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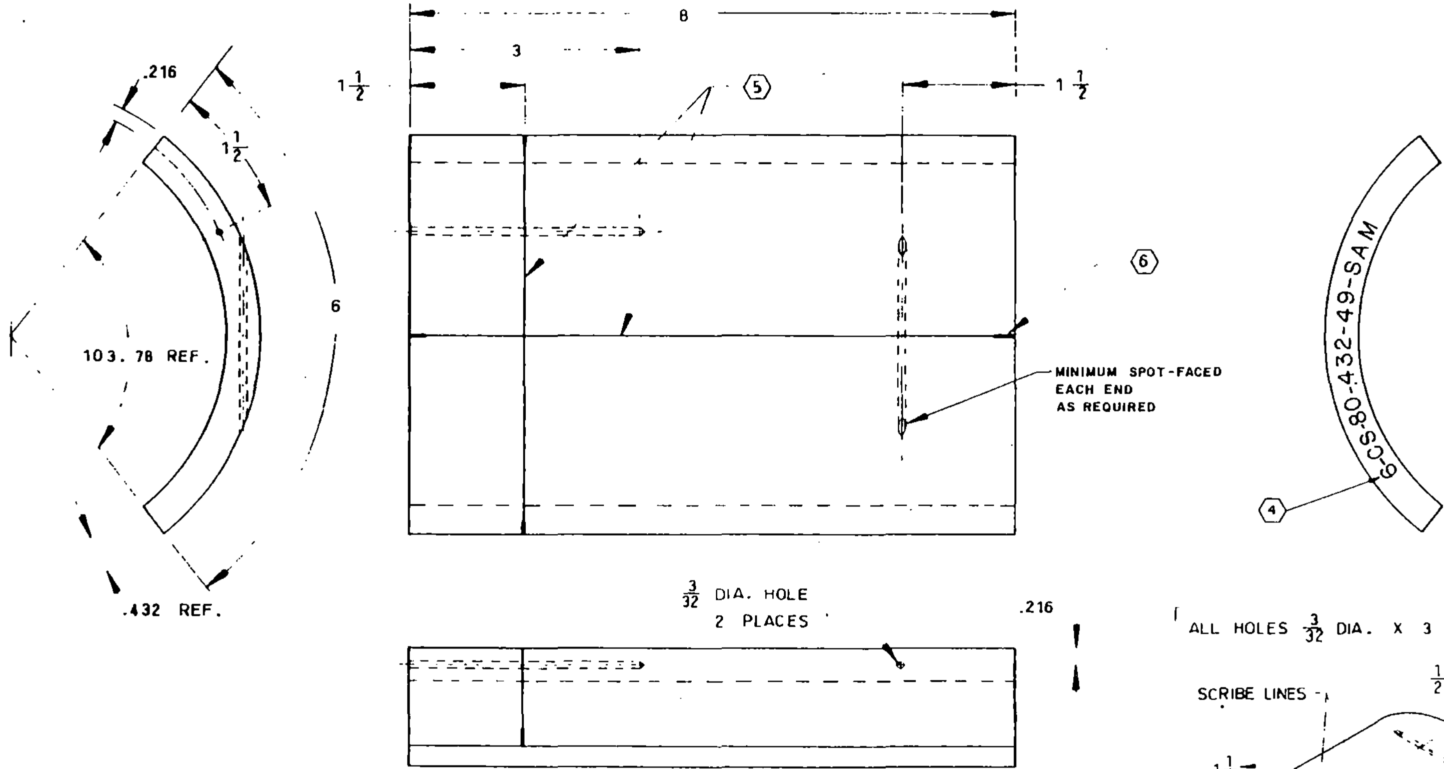

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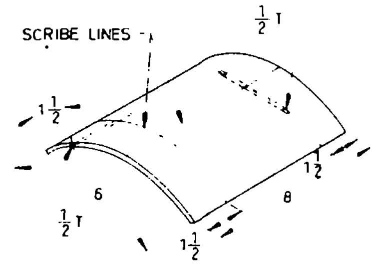


ID. NO. 6"-CS-80-.432-49-SAM

NOTES:

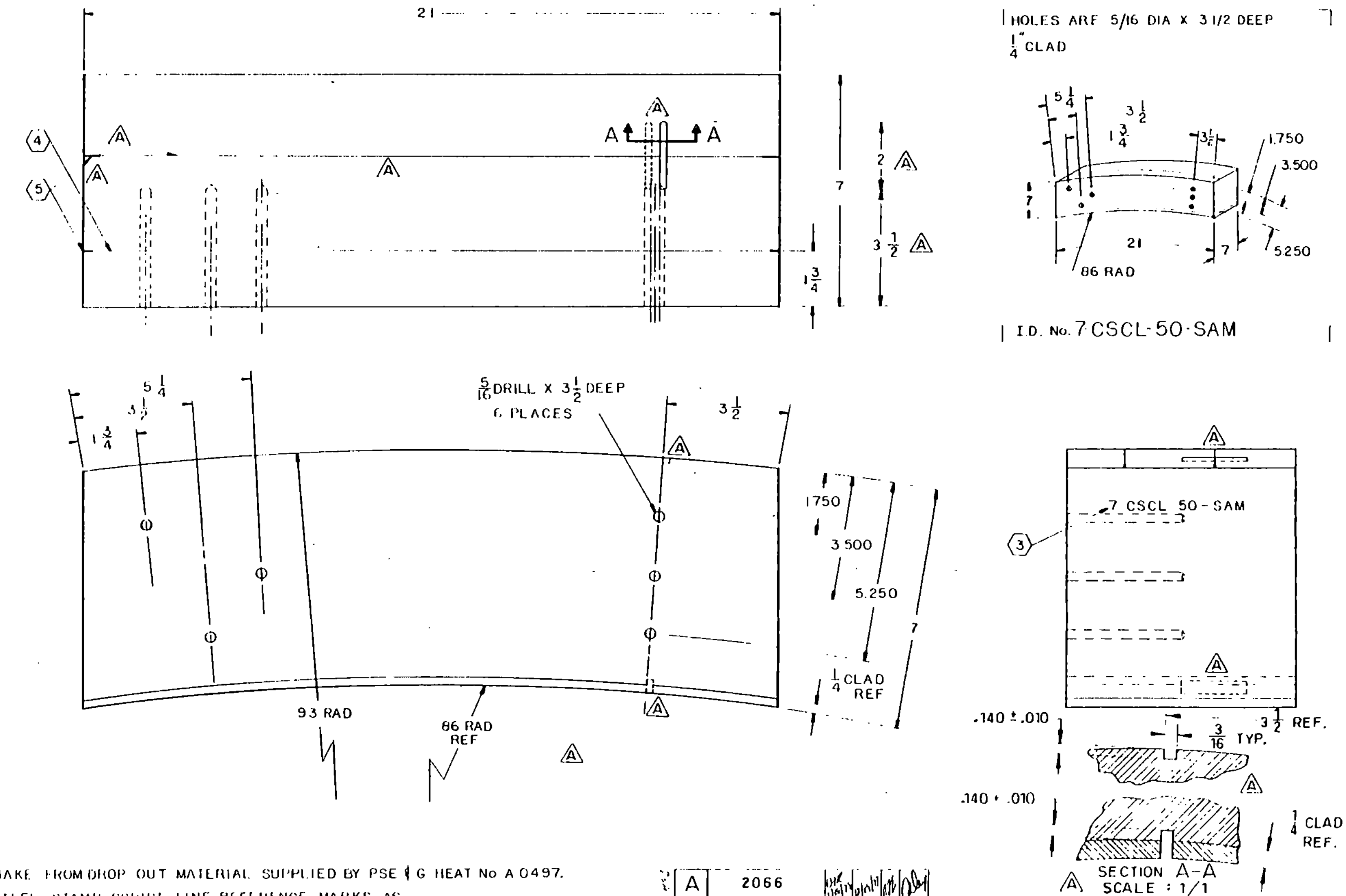
1. BREAK ALL SHARP EDGES AND REMOVE BURRS.
2. DIMENSIONS ARE IN INCHES.
3. MATERIAL FOR STANDARD TO BE FREE OF:
   PIPE SEAM WELDS,
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT
   ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
4. STEEL STAMP STANDARD ID. NO. AS SHOWN, ON SURFACE INDICATED, IN CHARACTERS 3/16 MINIMUM HEIGHT.
5. SCRIBE 2 CENTERLINES AS SHOWN .003 TO .005 WIDE AND DEEP.
6. STEEL STAMP SCRIBE LINE REFERENCE MARKS 1/32 WIDE AND DEEP X 1/4 LONG AS SHOWN.
7. MAKE FROM 6" SCH. 80 PIPE SUPPLIED BY PSE & G HEAT NO. L84439.

PIPE STANDARD	6" SCH 80 PIPE	7
PART NAME	FOR 11-11-75	MATERIAL
PARTS LIST		

LET	CHANGE	DATE	BY	APP
REVISIONS				

DRAWN BY F. CASTRO	NO REQ'D	TOLERANCES UNLESS NOTED DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'
DESIGNED BY	MATERIAL SEE P/L	6" SCH. 80 PIPE U. T. REF. STANDARD SALEM
CHECKED BY [signature]	HEAT TREAT ∼	SOUTHWEST RESEARCH INSTITUTE SAN ANTONIO TEXAS
APPROVED BY A. R. Whiting	FINISH 125	DATE 24 OCT 75 SCALE 1/1 DRAWING NUMBER C-3052 061

SK 114



⑥ MAKE FROM DROP OUT MATERIAL SUPPLIED BY PSE & G HEAT No A 0497.
⑤ STEEL STAMP SCRIBE LINE REFERENCE MARKS AS SHOWN 1/4 LONG X 1/32 DEEP.
④ SCRIBE LINE AS SHOWN .003-.005 WIDE AND DEEP.
③ STEEL STAMP I.D. No AS SHOWN, ON SURFACE INDICATED, 3/16 MIN LETTER HEIGHT
②
1 REMOVE BURRS & BREAK EDGES 1/32.
NOTES:

QA-L6 Nelson 8-18-77

LET.	DCN NO	APP	DATE	CHK	APP
A	2066				

REVISIONS

DRAWN BY	J. RAMOS
DESIGNED BY	J CRANE
CHECKED BY	
APPROVED BY	
MATERIAL	⑥
FINISH	125

PARTS LIST

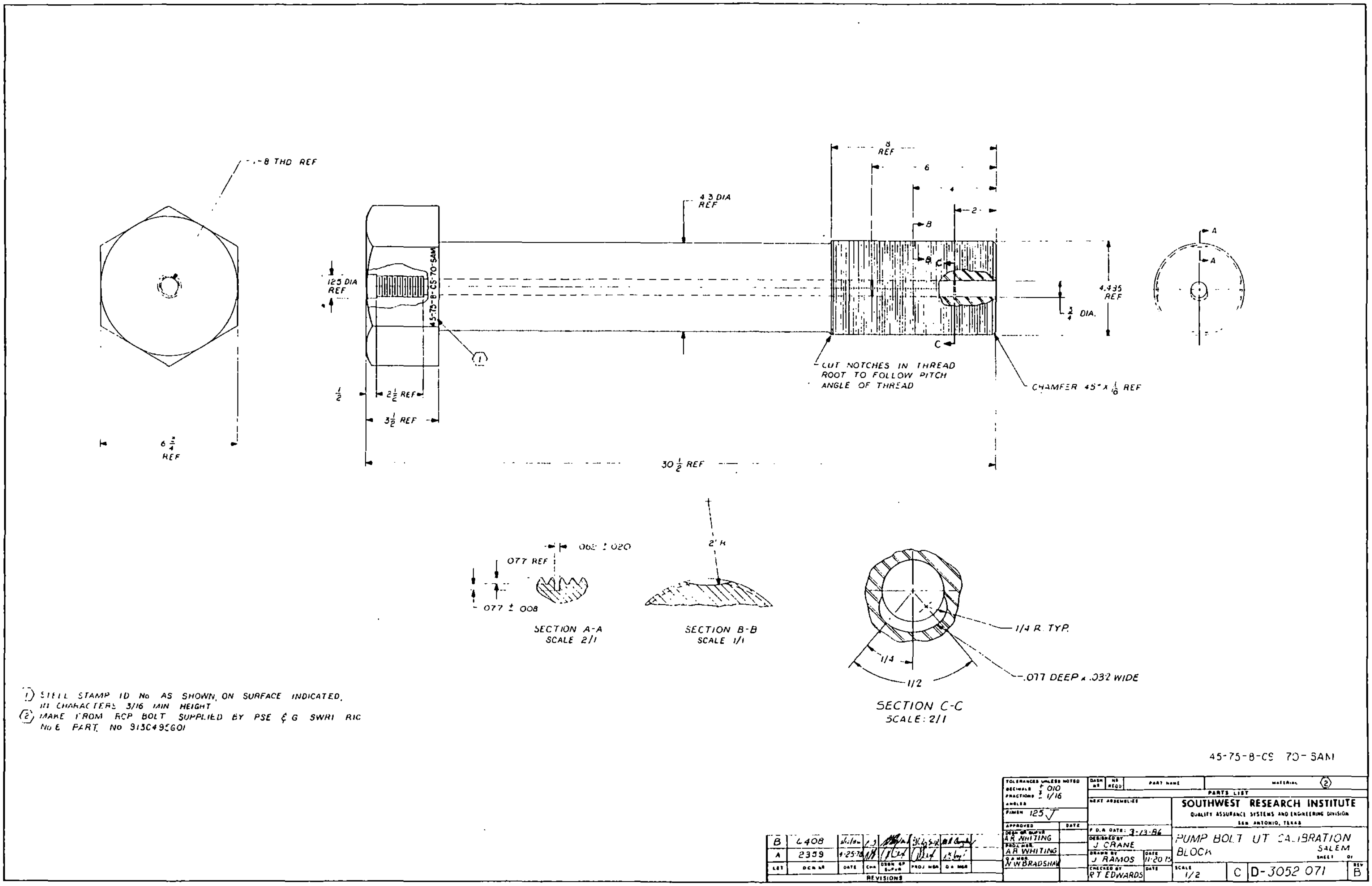
PART NAME: 7" CLAD PLATE U.T. CALIBRATION STANDARD

TOLERANCES UNLESS NOTED: DECIMALS ± .010, FRACTIONS ± 1/16, ANGLES ± 1/2°

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

DATE 11-19-75 SCALE 1/2

DRAWING NUMBER C-3052069A



-8 THD REF
43 DIA REF
125 DIA REF
45-75-8-CS-70-SAM
1/2
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3 1/2 REF
6 3/4 REF
30 1/2 REF
8 REF
6
4
2
B
C
A
4.435 REF
3/4 DIA.
CUT NOTCHES IN THREAD ROOT TO FOLLOW PITCH ANGLE OF THREAD
CHAMFER 45° x 1/8 REF
.077 REF
.062 ± .020
.077 ± .008
SECTION A-A
SCALE 2/1
2' R
SECTION B-B
SCALE 1/1
1/4 R TYP.
.077 DEEP x .032 WIDE
1/4
1/2
SECTION C-C
SCALE: 2/1
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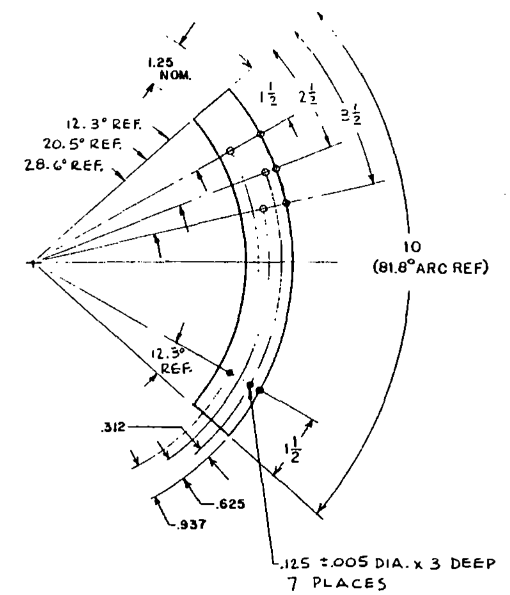
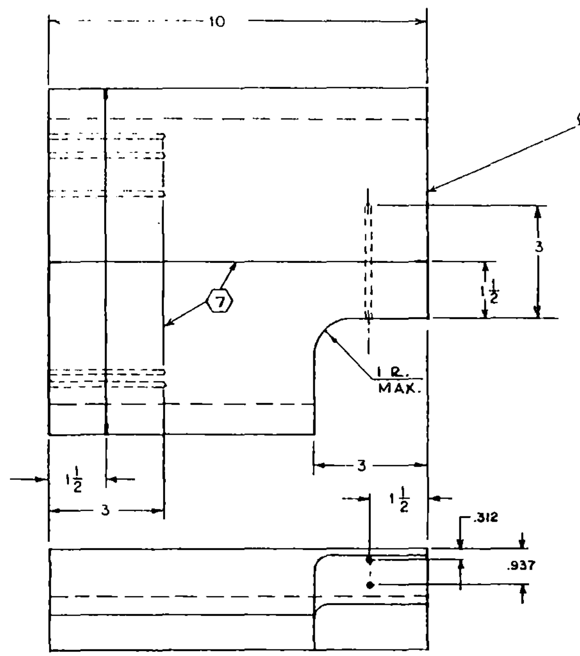
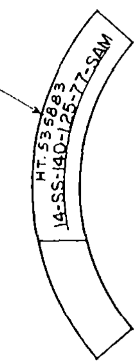
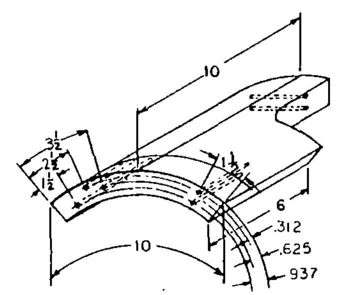
2) MAKE FROM RCP BOLT SUPPLIED BY PSE & G SWRI RIC No 6 PART No 913C495G01
45-75-8-CS 70-SAM
TOLERANCES UNLESS NOTED
DECIMALS ± .010
FRACTIONS ± 1/16
ANGLES
FINISH 125
APPROVED
DATE
DSGN OR SUPVR A R WHITING
PROJ MGR A R WHITING
Q A MGR N W BRADSHAW
DASH NO
NO REQD
PART NAME
MATERIAL 2
PARTS LIST
NEXT ASSEMBLIES
SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS
P.O.A DATE: 3-13-86
DESIGNED BY J CRANE
DRAWN BY J RAMOS
DATE 11-20-75
CHECKED BY R T EDWARDS
PUMP BOLT UT CALIBRATION BLOCK
SALEM
SHEET OF
SCALE 1/2
C
D-3052 071
REV B
B 6408
A 2359 4-25-78
LET
DCN NO
DATE
CHK
DSGN OR SUPVR
PROJ MGR
QA MGR
REVISIONS







ALL HOLES ARE .125 DIA x 3 DEEP



ID. No. 14-SS-140-1.25-77-SAM

NOTES:

1. DIMENSIONS ARE IN INCHES.
2. DEBURR & BREAK SHARP EDGES 1/64.
3. DO NOT MACHINE OR ALTER ID. OR O.D. SURFACES.
4. I.D. & O.D SURFACES TO BE FREE OF TOOL MARKS.
5. MATERIAL FOR STANDARD TO BE FREE OF:
   PIPE SEAM WELDS,
   FABRICATION OR REPAIR WELDS,
   ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.

(6) STEEL STAMP BLOCK ID No AND HEAT No, AS SHOWN, ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.

(7) SCRIBE CENTERLINES, AS SHOWN, .003 TO .005 WIDE AND DEEP. STEEL STAMP OR MILL CUT AN INDEX MARK AT EACH END OF CENTERLINE, AS SHOWN, 1/32 x 1/32 x 1/4 LONG.

(8) MAKE FROM 14" SCH. 140 PIPE, SA 312 TYPE 316, HEAT No 535883 SWRI RIR No 0470

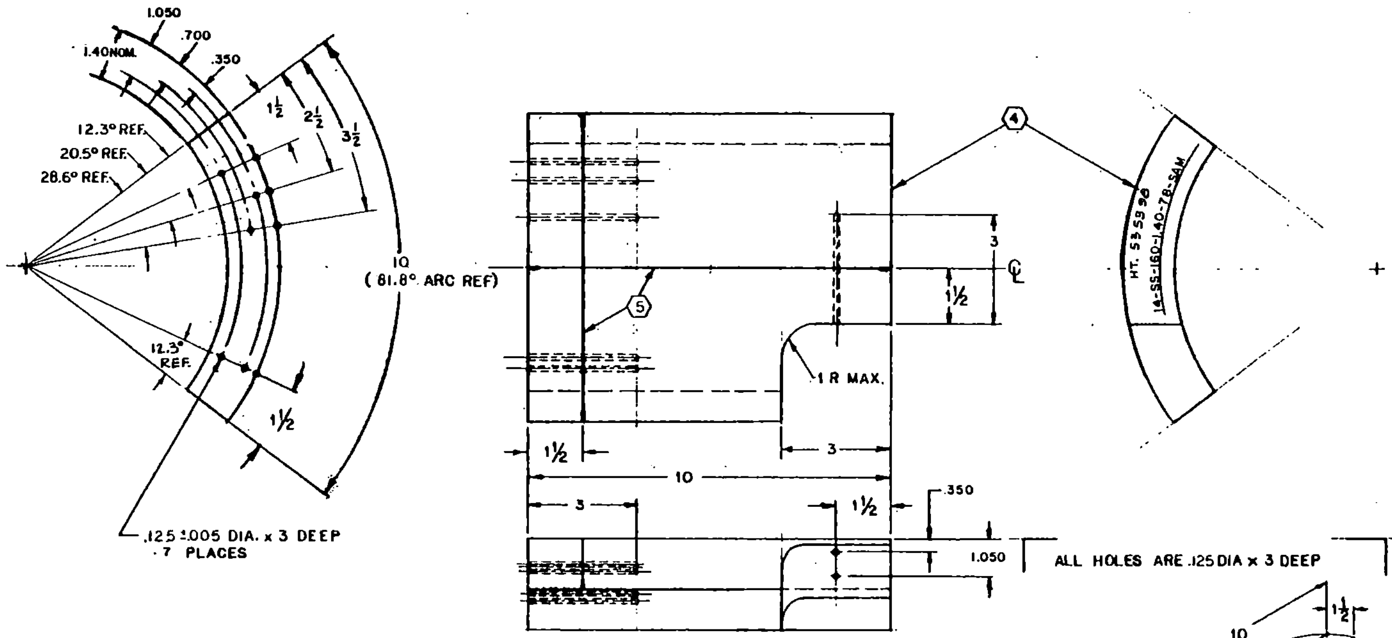
LTR.	CHANGE	CHK	DATE	APP	APP.
A	DCN-822		2 APR 76		

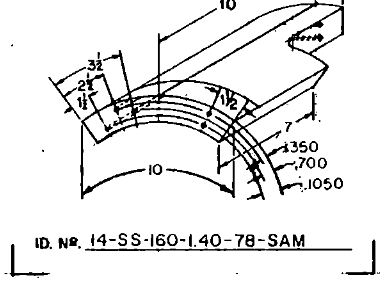
REVISIONS

DASH NO	NO. REQD.	PART NAME	MATERIAL
		FDR 4-5-76	

PARTS LIST

DRAWN BY J Wilkinson	NO REQ'D	TOLERANCES UNLESS NOTED: DECIMALS ± .010, FRACTIONS ± 1/16, ANGLES ± 1°	14" SCH 140 PIPE CALIBRATION BLOCK SALEM
CHECKED	MATERIAL (8)	SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO, TEXAS	DATE 1-31-76 SCALE 1/2
APPROVED	HEAT TREAT	C I	DRAWING NUMBER C-3052166 A
APPROVED	FINISH 125		





NOTES:

1. BREAK ALL SHARP EDGES & REMOVE BURRS.
2. DO NOT MACHINE OR ALTER I.D. OR O.D. SURFACES.
3. MATERIAL IS TO BE FREE OF WELDS & LAMINATES WHICH MAY AFFECT CALIBRATION.
4. STEEL STAMP BLOCK ID NO AND HEAT ID NO, AS SHOWN, ON SURFACE INDICATED IN CHARACTERS 3/16 MIN. HEIGHT.
5. SCRIBE CENTERLINES, AS SHOWN, .003 TO .005 WIDE AND DEEP. STEEL STAMP OR MILL CUT AN INDEX MARK AT EACH END OF CENTERLINE, AS SHOWN, 1/32 x 1/32 x 1/4 LONG.
6. MAKE FROM 14" SCH. 160 PIPE, SA 312 TYPE 316, HEAT NO 535398, SWRI RIR NO 0470.

LTR.	CHANGE	CHK	DATE	APP.	APP.
A	DCN - 823		3-26-76		

REVISIONS

FOR 4-5-76

PARTS LIST

DRAWN BY J. WILKINSON

CHECKED 3/26/76

APPROVED

MATERIAL (6)

FINISH 125

TOLERANCES UNLESS NOTED: DECIMALS ± .010, FRACTIONS ± 1/16, ANGLES ± 1°

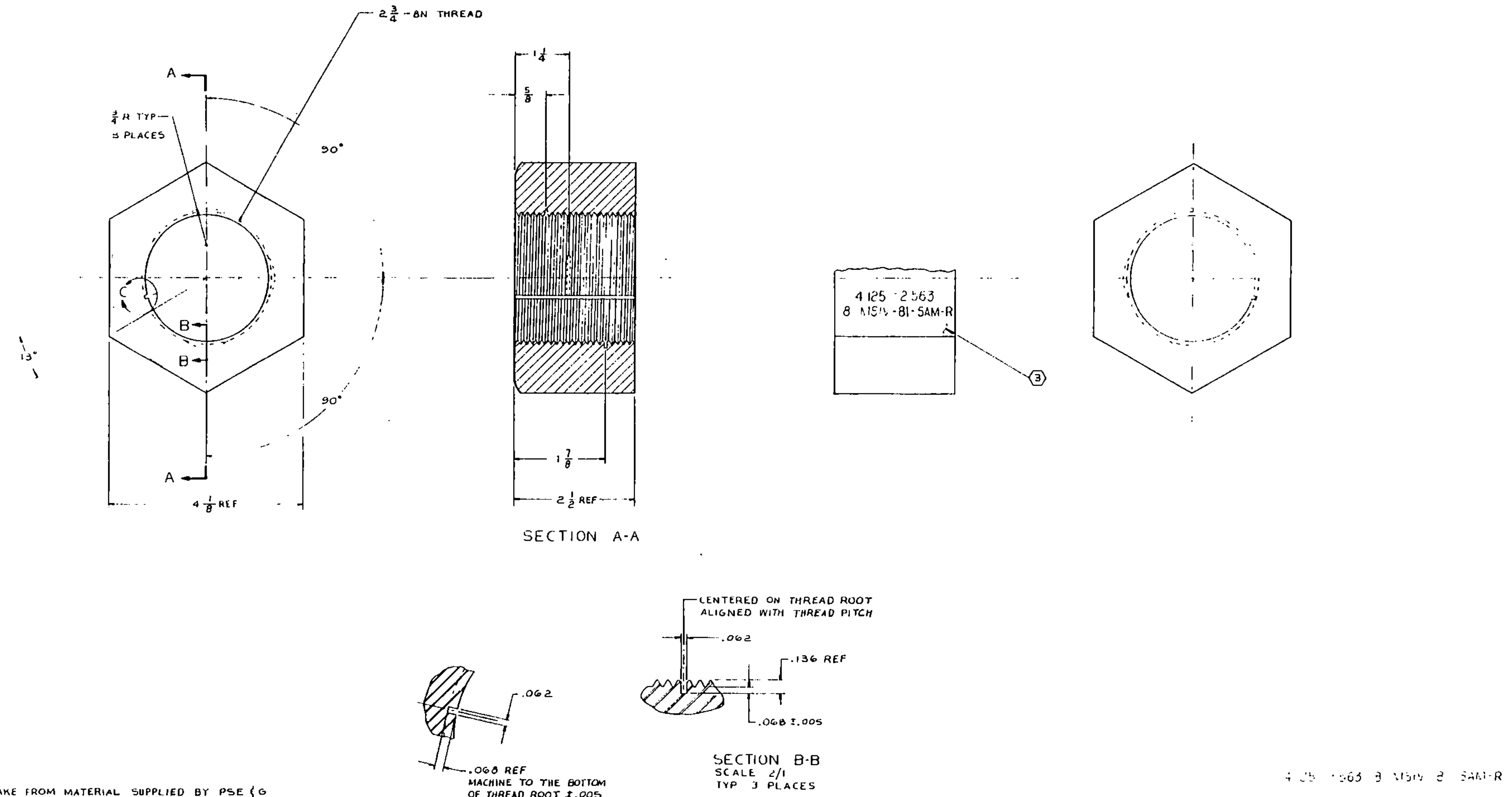
14" SCH 160 PIPE CALIBRATION BLOCK SALEM

SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO, TEXAS

DATE 1-31-76 SCALE 1/2

DRAWING NUMBER C-3052167 A

SK 182



DETAIL C
SCALE 2/1

4. MAKE FROM MATERIAL SUPPLIED BY PSE & G SwRI RIC No. 175.
3. STEEL STAMP ID. No. ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.
2. MATERIAL FOR BLOCK TO BE FREE OF: FABRICATION OR REPAIR WELDS, ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
1. BREAK SHARP EDGES AND REMOVE BURRS.

NOTES:

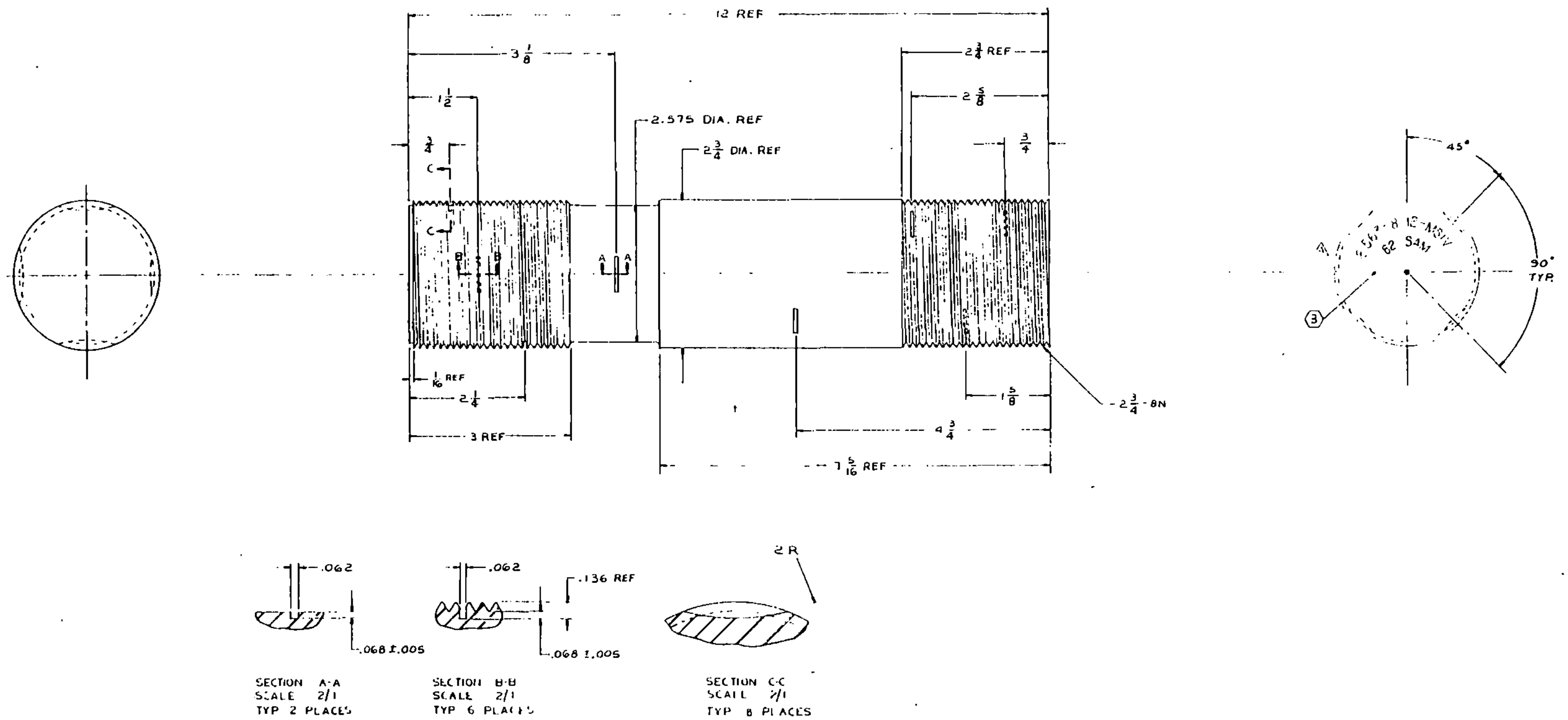
4 125 2563 8 MSIV 2 SAM-R

SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

MAIN STEAM STOP VALVE NUT UT CALIB BLOCK
SALEM

SCALE 1/1 C D-3052-607

REVISIONS



2563 8 12 MSIV 62-SAM

(4) MAKE FROM MATERIAL SUPPLIED BY PSE AND G SwRI RIC Nº 13A.

(3) STEEL STAMP ID. NO. ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.

2 MATERIAL FOR BLOCK TO BE FREE OF:
FABRICATION OR REPAIR WELDS, ANY
LAMINAR INDICATIONS WHICH MAY AFFECT
ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.

1 BREAK SHARP EDGES AND REMOVE BURRS.

NOTES:

LET	DCN NO	DATE	CHK	DSGN OF SUPVR	PROJ MGR	QA MGR
A	2432	5-24-78				

REVISIONS

TOLERANCES UNLESS NOTED
DECIMALS ± .010
FRACTIONS ± 1/16
ANGLES ± 1°
FINISH 125

F.D.R. DATE 5-25-78

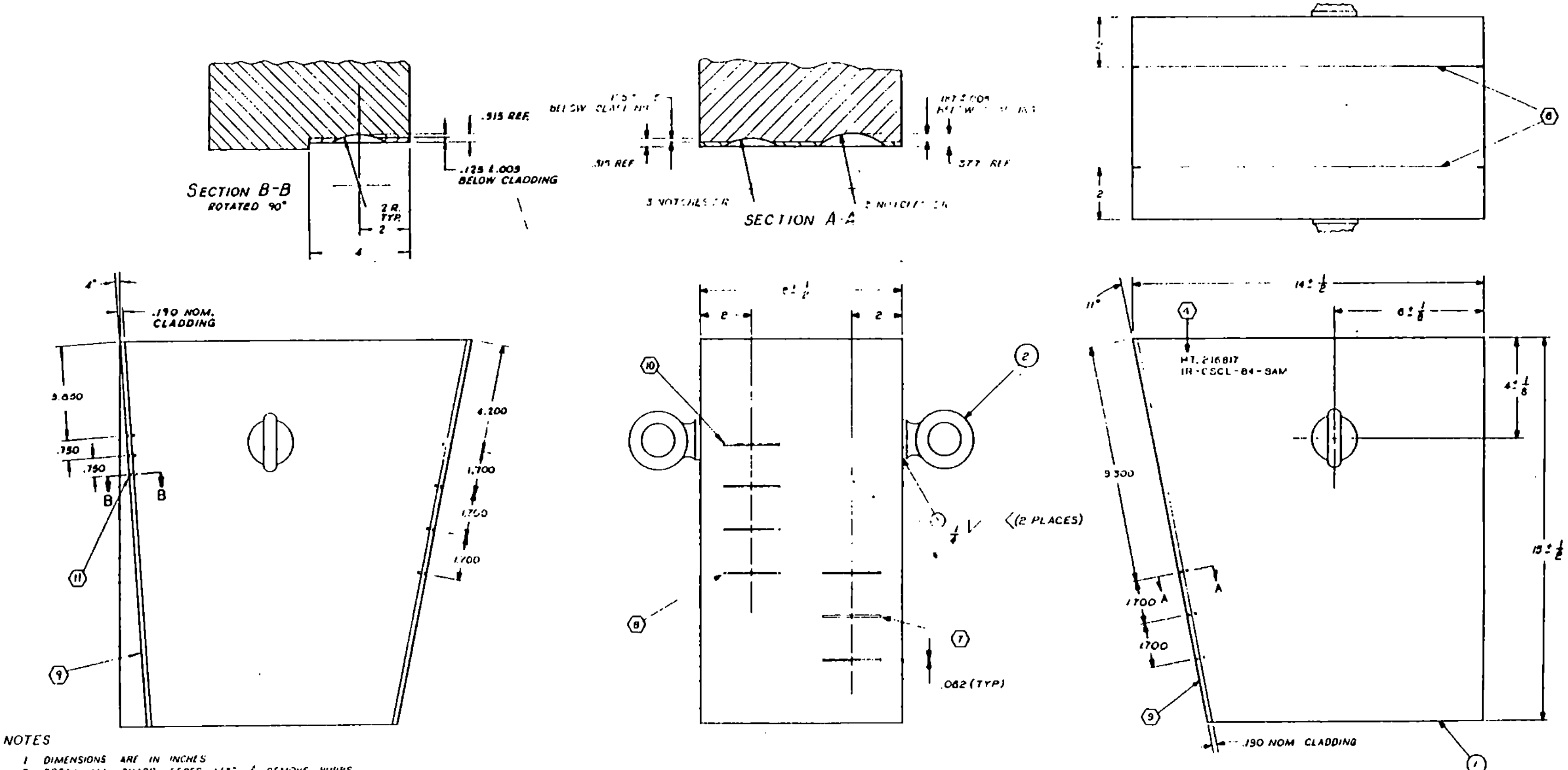
DRAWN BY RAMOS DATE 4-11-78

SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

MAIN STEAM STOP VALVE STUD UT CALIB BLOCK
SALEM

SCALE 1/1 | C | D-3052239 | REV A

D-13



NOTES

1. DIMENSIONS ARE IN INCHES
2. BREAK ALL SHARP EDGES 1/32 & REMOVE BURRS
3. ULTRASONIC EXAMINATION TO BE PERFORMED IN ACCORDANCE WITH ASME SECTION XI, 1971, ARTICLE 23, SA578 INCLUDING ACCEPTANCE STANDARD LEVEL I AND SUPPLEMENTARY REQUIREMENTS S1 PRIOR TO MACHINING

(4) STEEL STAMP ID NO & HEAT NO AS SHOWN ON SURFACE INDICATED, IN CHARACTERS 3/16 MINIMUM HEIGHT

(5) MAKE FROM SA508 CL II, HT NO [illegible] NO 0758C

(6) STEEL STAMP INDEX MARKS 1/32 X 1/32 X 1/4 LONG, SCRIBE REFERENCE LINES .003 .005 WIDE & DEEP

(7) THESE NOTCHES ARE FOR CALIBRATION AND EXAMINATION OF THE STEAM GENERATOR [illegible] INSIDE RADIUS [illegible]

(8) THESE NOTCHES ARE FOR CALIBRATION [illegible] OF THE PRESSURIZER SURGE NOZZLE INSIDE [illegible]

(9) CLAD OVERLAY IN ACCORDANCE [illegible] REV 1

(10) THESE NOTCHES ARE FOR THE CALIBRATION AND EXAMINATION OF THE PRESSURIZER SAFETY & RELIEF NOZZLES.

(11) THESE NOTCHES ARE FOR THE CALIBRATION AND EXAMINATION OF THE PRESSURIZER SPRAY NOZZLE.

IR-CSCL-84-SAM

2	2	LIFTING EYE	NO. 3024T26 M^cMASTER-CARR
1	1	BLOCK	(5) CARBON STEEL
REQD	NO.	PART NAME	MATERIAL

PARTS LIST

TOLERANCES UNLESS NOTED: DECIMALS ±.010, FRACTIONS ±1/16, ANGLES ±30', FINISH 125

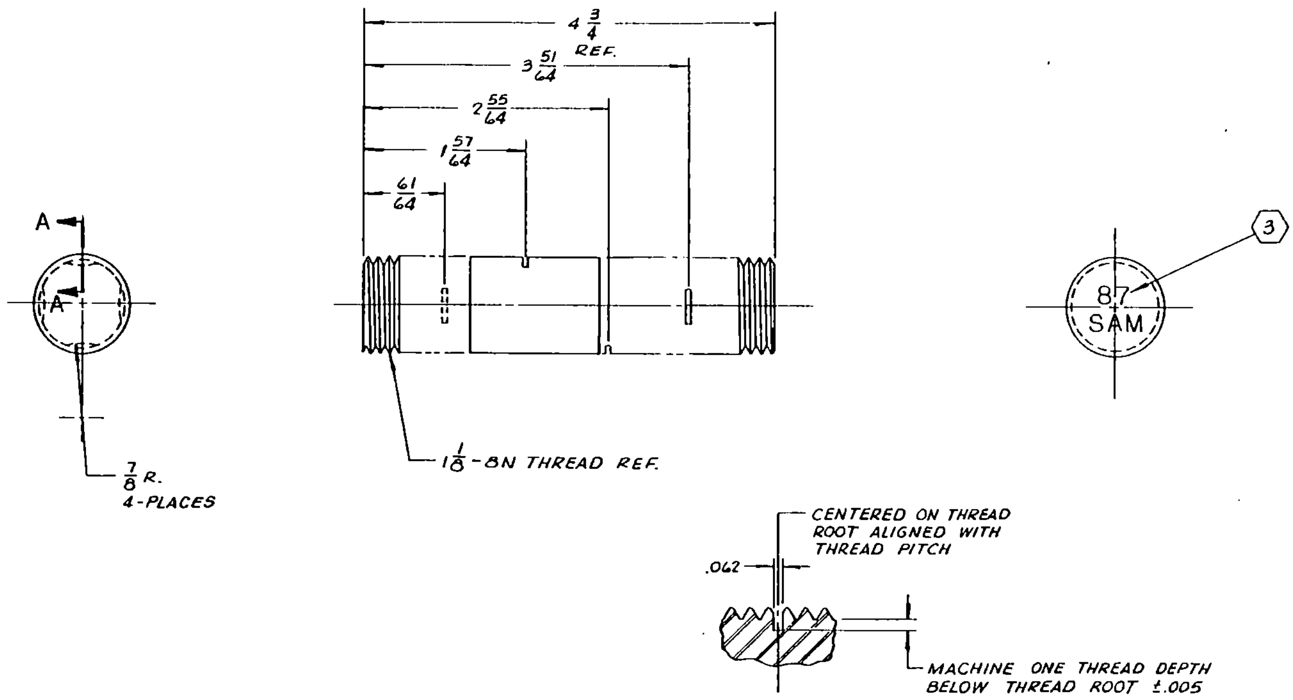
SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

O D INNER RADIUS UT CAL BLOCK — SALEM 2

P.D.R. DATE: 6/22/78 — DRAWN BY: C BLUM — SCALE: 1/2 — C — D-3052 241 — REV A

LET	ECN NO	DATE	CHK	ENGR	PROJ MGR	QA MGR
A	2509					

REVISIONS



SECTION A-A
SCALE: 2/1
TYP. 4 PLACES

NOTES:

1 DEBURR AND BREAK SHARP EDGES.

2 MATERIAL FOR BLOCK TO BE FREE OF: FABRICATION OR REPAIR WELDS, ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.

3 STEEL STAMP ID. NO. SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.

4 MAKE FROM STUD SUPPLIED BY PSE & G SWRI RIC NO. 56.

1.125-8-S-CS-87-SAM

LET	DCN Nº	DATE	CHK	DSGN. GP. SUPVR.	PROJ. MGR	Q A MGR

REVISIONS

TOLERANCES UNLESS NOTED
DECIMALS ±.010
FRACTIONS ± 1/16
ANGLES
FINISH 125

APPROVED	DATE
DSGN GP SUPVR	6-13-78
PROJ. MGR	6-13-78
Q A MGR	13 June 78

DASH Nº	Nº REQD	PART NAME	MATERIAL
			4

PARTS LIST

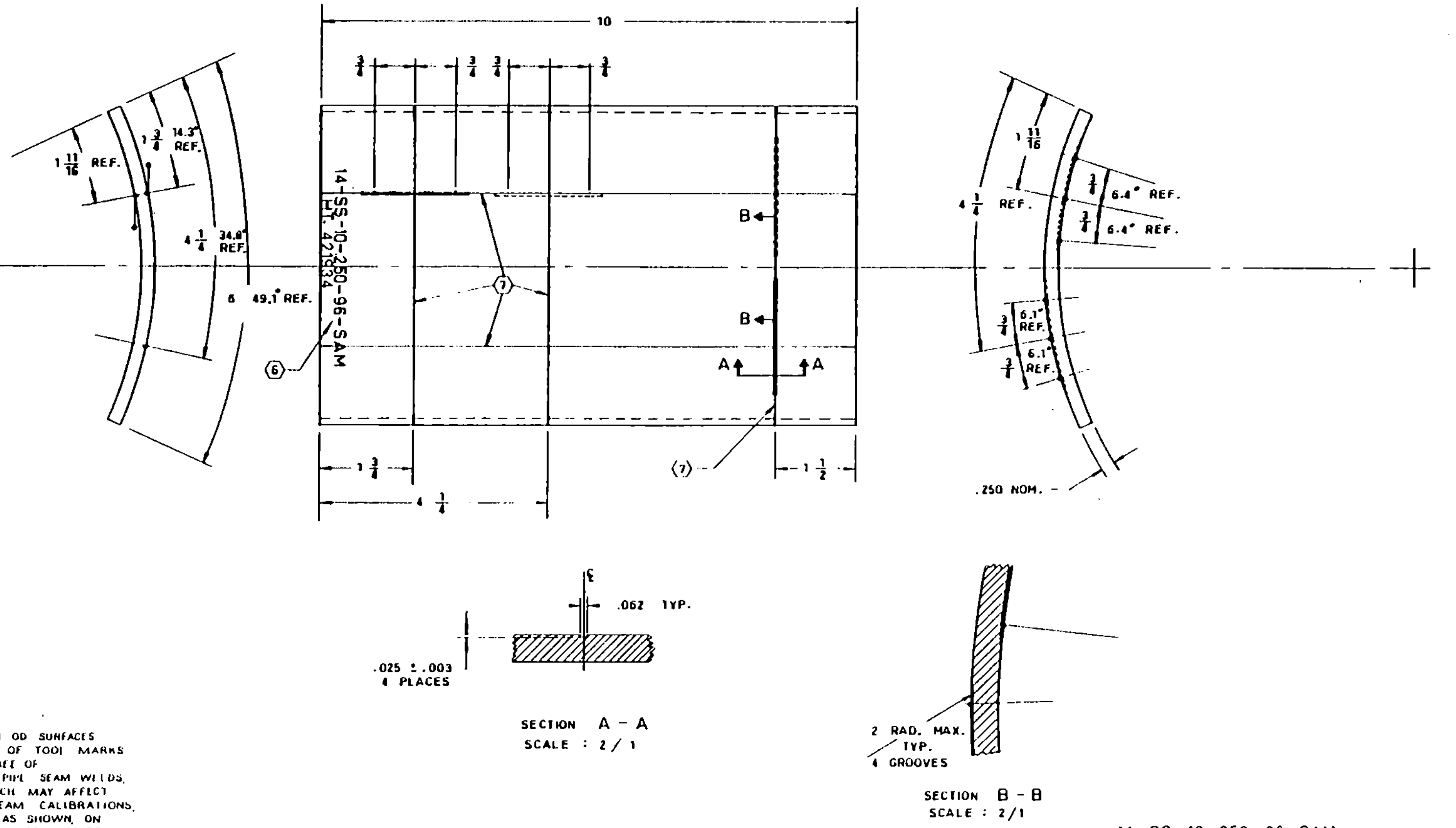
NEXT ASSEMBLIES

F.D.R. DATE: 6/12/78
DRAWN BY — DATE 6/8/78
CHECKED BY — DATE

SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

STUD CALIBRATION BLOCK

SALEM 2
SCALE 1/1
SHEET OF
C C-3052-251
REV.



14-SS-10-.250-96-SAM

NOTES
1 DIMENSIONS ARE IN INCHES
2 DEBURR & BREAK SHARP EDGES
3 DO NOT MACHINE OR ALTER ID OR OD SURFACES
4 ID & OD SURFACES TO BE FREE OF TOOL MARKS
5 MATERIAL FOR BLOCK TO BE FREE OF FABRICATION OR REPAIR WELDS, PIPE SEAM WELDS, ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
(6) STEEL STAMP ID NO & HEAT No. AS SHOWN, ON SURFACE INDICATED AND WITHIN LIMITS OF AREA NOTED, IN CHARACTERS 3/16 MIN HEIGHT
(7) SCRIBE CENTERLINES .003 TO .005 WIDE AND DEEP WHERE NOTED. STEEL STAMP, OR MILL CUT, AN INDEX MARK AT EACH END OF CENTERLINES AS SHOWN. 1/32 x 1/32 x 1/4 LONG
(8) MAKE FROM 14" PIPE, SCHEDULE 10, HEAT No 421934, SwRI LOG No 0358 H

TOLERANCES UNLESS NOTED: DECIMALS ± .010; FRACTIONS ± 1/16; ANGLES ± 0° 30'; FINISH 125

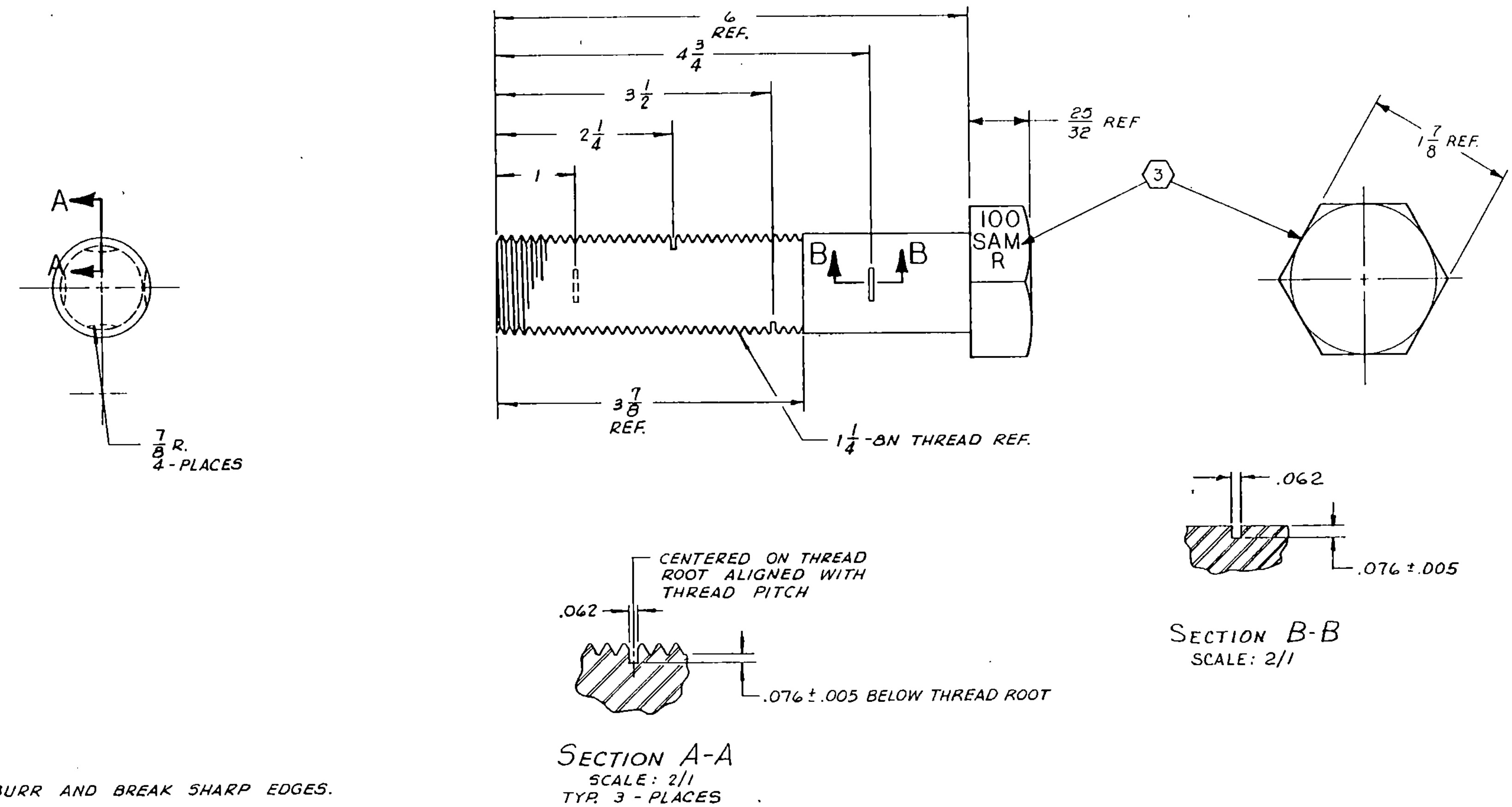
PARTS LIST — (8) — MATERIAL

SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

14" PIPE ULTRASONIC CALIBRATION BLOCK
SALEM 2
SHEET 1 OF 1

DRAWN BY F. CASTRO
SCALE 1/1 C D-3052 253

REVISIONS



NOTES:

1. DEBURR AND BREAK SHARP EDGES.
2. MATERIAL FOR BLOCK TO BE FREE OF: ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.
3. STEEL STAMP ID. NO. AS SHOWN ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.
4. MAKE FROM BOLT SUPPLIED BY SWRI HEAT NO. 1120985 SWRI LOG NO. 2204

1.250-8-B-CS-100-SAM-R

DASH Nº	Nº REQD	PART NAME	MATERIAL
			4

PARTS LIST

TOLERANCES UNLESS NOTED
DECIMALS ±.010
FRACTIONS ±1/16
ANGLES
FINISH 125

APPROVED	DATE
DSGN GP SUPVR [signature]	4/11/86
PROJ MGR [signature]	4/11/86
Q A MGR [signature]	4/11/86

NEXT ASSEMBLIES

F O R. DATE 4-16-86

DRAWN BY	DATE
R. V. Hernandez	4/4/86
CHECKED BY	DATE
[signature]	4/8/86

SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

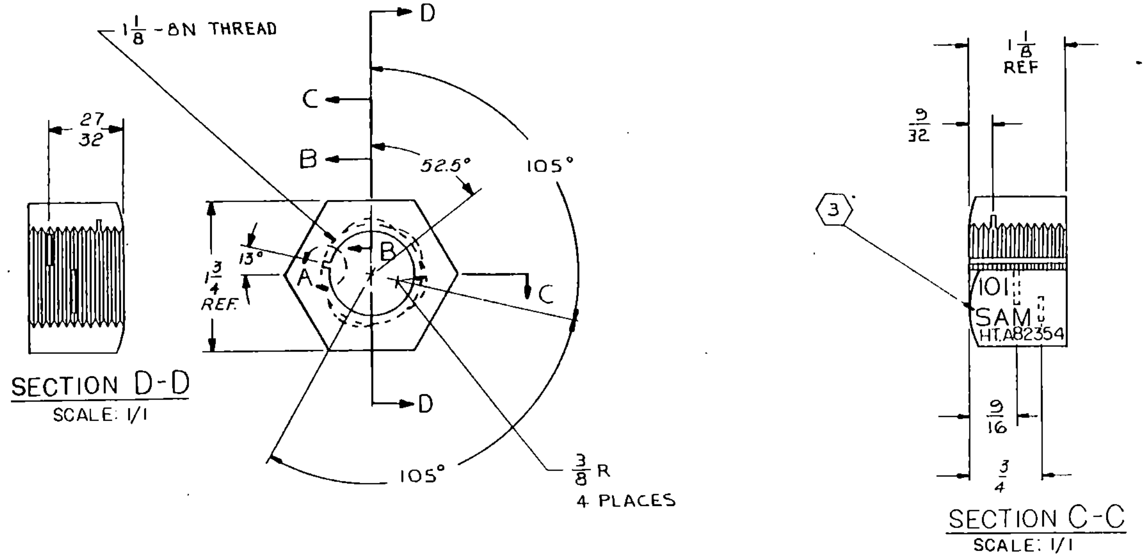
BOLT CALIBRATION BLOCK

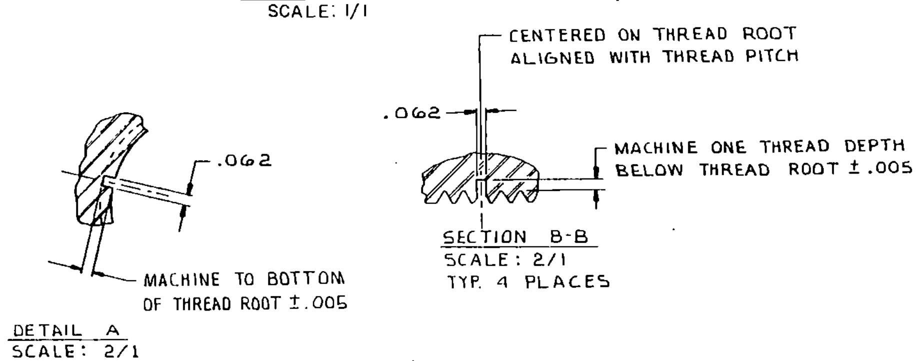
SALEM 2

SCALE 1/1 | SHEET OF | C | C-3052-600 | REV. A

LET	DCN Nº	DATE	CHK	DSGN GP. SUPVR.	PROJ. MGR.	Q A MGR
A	6430	4/16/86	[illegible]	[signature]	[signature]	[signature]

REVISIONS





NOTES:

1 DEBURR AND BREAK SHARP EDGES.

2 MATERIAL FOR BLOCK TO BE FREE OF: FABRICATION OR REPAIR WELDS, ANY LAMINAR INDICATIONS WHICH MAY AFFECT ANGLE BEAM OR STRAIGHT BEAM CALIBRATIONS.

3 STEEL STAMP ID. Nº. ON SURFACE INDICATED, IN CHARACTERS 3/16 MIN. HEIGHT.

4 MAKE FROM NUT SUPPLIED BY PSE & G SwRI RIC Nº. 66F, SA 194 - 2H, HEAT NO. A82354

1.125-8-N-CS-101-SAM

LET	DCN Nº	DATE	CHK	DSGN GP. SUPVR	PROJ. MGR.	Q.A. MGR
A	2743	10-16-78	[illegible]	[signature]	[signature]	[signature]

REVISIONS

TOLERANCES UNLESS NOTED
DECIMALS ±.010
FRACTIONS ±1/16
ANGLES ±1°
FINISH 125

APPROVED	DATE
DSGN GP SUPVR [signature]	10/16/78
PROJ. MGR. [signature]	[illegible]
Q.A. MGR J.E. McDonald	10/16/78

DASH Nº	Nº REQD	PART NAME	MATERIAL
			4

PARTS LIST

NEXT ASSEMBLIES

P.D.R. DATE: 10-17-78

DRAWN BY RAMOS — DATE 10-6-78

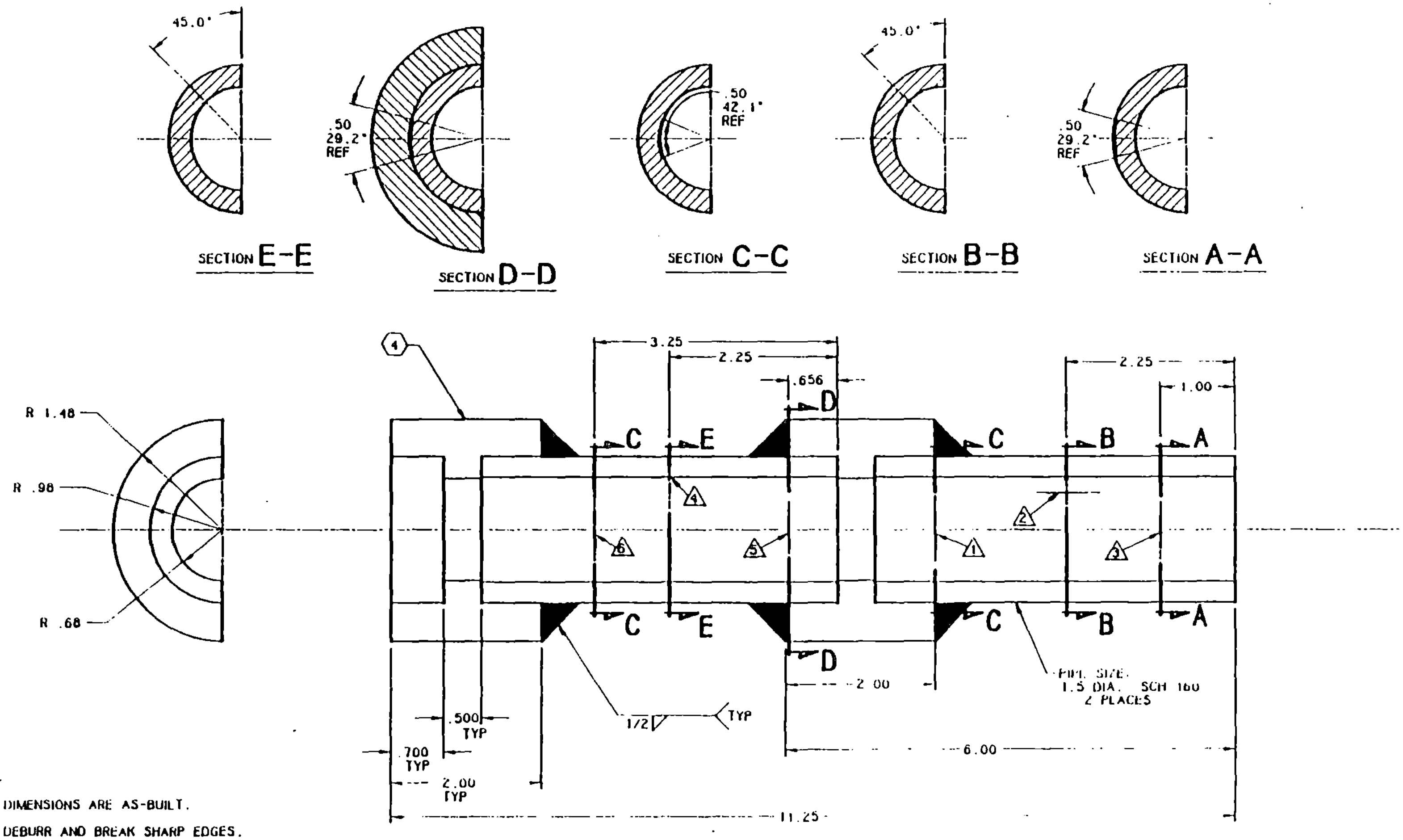
CHECKED BY [signature] — DATE 10/9/78

SOUTHWEST RESEARCH INSTITUTE
QUALITY ASSURANCE SYSTEMS AND ENGINEERING DIVISION
SAN ANTONIO, TEXAS

NUT CALIBRATION BLOCK

SALEM 2 — SHEET OF

SCALE 1/1 — C — C-3052 256 — REV. A



NOTES:

1. DIMENSIONS ARE AS-BUILT.
2. DEBURR AND BREAK SHARP EDGES.
3. MAKE FROM MATERIAL PROVIDED BY PSG&E MATERIAL INFORMATION STAMPED ON OUTER SURFACE OF SOCKET: A403-W-P-31C A182-F-31C-C
4. INSCRIBE ID. No IN CHARACTERS .12 MIN HEIGHT WITH VIBRO TOOL.
5. ALL NOTCHES ARE EDM. .028 DEEP x .010 WIDE x .5 LONG.

ID.No. 1.5-SS-COUP-111-SAM

TOLERANCES UNLESS NOTED	
DECIMALS	.xx ±.1 / .xxx ±.03
FRACTIONS	.xxxx ±.010
ANGLES	±1.0°
FINISH	125

APPROVED	DATE
DESIGN QUAL. R.L. Edwards	11/9/88
PROJ. MGR. J.R. Ingamells	11/11/88
Q.A. MGR. R.D. Brient	11/11/88
CAD PLOT FILE NO SAM-605	

DASH NO. | NO. REQD | PART NAME | MATERIAL

PARTS LIST

NEXT ASSEMBLIES

P.O.B. DATE:

DESIGNED BY	DATE
R.L. Edwards	
DRAWN BY	DATE
J. Wilkinson	10/6/88
CHECKED BY	DATE
R.V. Hernandez	11/9/88

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EVALUATION SCIENCE & TECHNOLOGY DIVISION
SAN ANTONIO, TEXAS

SOCKET WELD CALIBRATION BLOCK

SCALE 1/1 | C | C-3052-605 | SH. 1 of 1 | REV.

LET	DCN NO.	DATE	CHK.	DSGN MGR	PROJ MGR	Q A MGR

REVISIONS

APPENDIX E

CERTIFICATES OF PERSONNEL QUALIFICATIONS

APPENDIX E

CERTIFICATES OF PERSONNEL QUALIFICATIONS

Table of Contents

ITR = Level I Trainee

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Todd Bohnenkamper

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated South Spencer H.S., Rockport, Indiana, 1982.
Attended Indiana St. Univ for 2 years.

TRAINING (For this certification): 66 hours.

EXPERIENCE (Initial certification): 9 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	85.71	01/17/89
Specific	0.30	88.00	01/26/89
Practical	0.40	85.00	01/27/89
Composite		86.11	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 08/09/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 14 March 1988

Date of Initial Level II Certification: 14 March 1989

Date of Expiration: 14 March 1992

REMARKS:

SIGNED: James C. McArdle
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

11/08/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Todd Bohnenkamper

is qualified as Level II in LIQUID PENETRANT testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated South Spencer H.S., Rockport, Indiana, 1982. Attended Indiana St. Univ for 2 years.

TRAINING (For this certification): 21 hours.

EXPERIENCE (Initial certification): 5 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	90.00	06/16/89
Specific	0.30	85.00	06/16/89
Practical	0.40	81.50	06/22/89
Composite		85.10	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No **Date:** 08/09/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 23 August 1989

Date of Expiration: 23 August 1992

REMARKS:

SIGNED: James J. McArdle
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

08/29/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Todd Bohnenkamper

is qualified as Level I in MAGNETIC PARTICLE testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated South Spencer H.S., Rockport, Indiana, 1982.
Attended Indiana St. Univ for 2 years.

TRAINING (For this certification): 18 hours.

EXPERIENCE (Initial certification): 2 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	75.00	06/08/89
Specific	0.30	91.00	06/08/89
Practical	0.40	95.00	06/08/89
Composite		87.80	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 08/09/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 24 July 1989

Date of Expiration: 24 July 1992

REMARKS:

SIGNED: [signature]
Responsible Level III

[signature]
Director, Department of NDE Services

08/11/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Todd Bohnenkamper

is qualified as Level II in VISUAL testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated South Spencer H.S., Rockport, Indiana, 1982.
Attended Indiana St. Univ for 2 years.

TRAINING (For this certification): 35 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	77.50	01/26/90
Specific	0.33	85.00	01/26/90
Practical	0.33	87.00	01/29/90
Composite		83.17	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: No   Date: 08/09/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 16 March 1990

Date of Expiration: 16 March 1993

REMARKS:

SIGNED: Joel L. Godwin
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

03/21/90

Form QA-68-0

Sonic Systems International, Inc.
Specialists in Ultrasonic Testing and Consulting

CERTIFICATE OF QUALIFICATION

FOR

BILL DIETRICH

The aforementioned individual is qualified in accordance with Sonic Systems International's Training, Qualification and Certification Procedure Number SSI-A-005, which complies with the requirements of the American Society for Nondestructive Testing Recommended Practice Number SNT-TC-1A. This certification is based on background training, examination, and evaluation method indicated.

NDE Method	Level	Date	Expires
ULTRASONIC	I	1/26/89	1/26/92

Examination Results

General	77.5%	X	.3	=	23.2
Specific	96%	X	.2	=	19.2
Practical	85%	X	.5	=	42.5
			Composite Score	=	84.9

Certified NDE Level III Examiner

Quality Assurance Manager

Sonic Systems International, Inc.
Specialists in Ultrasonic Testing and Consulting

CERTIFICATE OF QUALIFICATION

FOR

BILL DIETRICH

The aforementioned individual is qualified in accordance with Sonic Systems International's Training, Qualification and Certification Procedure Number SSI-A-005, which complies with the requirements of the American Society for Nondestructive Testing Recommended Practice Number SNT-TC-1A. This certification is based on background training, examination, and evaluation method indicated.

NDE Method	Level	Date	Expires
LIQUID PENETRANT	II	1/26/89	1/26/92

Examination Results

General	80%	X	.3	=	24.0
Specific	100%	X	.2	=	20.0
Practical	95%	X	.5	=	47.5
			Composite Score	=	91.5

Certified NDE Level III Examiner

Quality Assurance Manager

Sonic Systems International, Inc.
Specialists in Ultrasonic Testing and Consulting

CERTIFICATE OF QUALIFICATION

FOR

BILL DIETRICH

The aforementioned individual is qualified in accordance with Sonic Systems International's Training, Qualification and Certification Procedure Number SSI-A-005, which complies with the requirements of the American Society for Nondestructive Testing Recommended Practice Number SNT-TC-1A. This certification is based on background training, examination, and evaluation method indicated.

NDE Method	Level	Date	Expires
MAGNETIC PARTICLE	II	1/26/89	1/26/92

Examination Results

General	80.2	X	.3	=	24.0
Specific	85	X	.2	=	17.0
Practical	80	X	.5	=	40.0
			Composite Score	=	81.0%

Certified NDE Level III Examiner

Quality Assurance Manager

Sonic Systems International, Inc.
Specialists in Ultrasonic Testing and Consulting

CERTIFICATE OF QUALIFICATION

FOR

BILL DIETRICH

The aforementioned individual is qualified in accordance with Sonic Systems International's Training, Qualification and Certification Procedure Number SSI-A-011, which complies with the requirements of the American Society for Nondestructive Testing Recommended Practice Number SNT-TC-1A. This certification is based on background training, examination, and evaluation method indicated.

NDE Method	Level	Date	Expires
VISUAL, VT-1	II	1/26/89	1/26/92

Examination Results

General	93.4%	X	.3	=	28.0
Specific	100%	X	.2	=	20.0
Practical	100%	X	.5	=	50.0
			Composite Score	=	98.0

Certified NDE Level III Examiner

Quality Assurance Manager

Sonic Systems International, Inc.
Specialists in Ultrasonic Testing and Consulting

CERTIFICATE OF QUALIFICATION

FOR

BILL DIETRICH

The aforementioned individual is qualified in accordance with Sonic Systems International's Training, Qualification and Certification Procedure Number SSI-A-011, which complies with the requirements of the American Society for Nondestructive Testing Recommended Practice Number SNT-TC-1A. This certification is based on background training, examination, and evaluation method indicated.

NDE Method	Level	Date	Expires
VISUAL, VT-3	II	1/26/89	1/26/92

Examination Results

General	88%	X	.3	=	26.4
Specific	90%	X	.2	=	18.0
Practical	100%	X	.5	=	50.0
			Composite Score	=	94.4

Wm Roberts
Certified NDE Level III Examiner

Quality Assurance Manager

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Eddie Escobedo

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Sidney Lanier H.S., San Antonio, Texas, 1970.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 118 hours.

EXPERIENCE (Initial certification): 12 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	92.00	06/26/87
Specific	0.30	96.00	06/26/87
Practical	0.40	90.00	06/26/87
Composite		92.40	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 01/19/90

CERTIFICATION HISTORY:

Date of Employment:	4 February 1980
Date of Initial Level I Certification:	18 August 1980
Date of Initial Level II Certification:	11 November 1981
Date of Most Recent Recertification:	1 July 1987
Date of Expiration:	1 July 1990

REMARKS: EPRI IGSCC Qualifications - Manual Detection

SIGNED: James F. McArdle Jr.
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

01/19/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Eddie Escobedo

is qualified as Level II in LIQUID PENETRANT testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Sidney Lanier H.S., San Antonio, Texas, 1970.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 26 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	83.30	02/26/88
Specific	0.30	80.00	02/26/88
Practical	0.40	95.00	02/24/88
Composite		86.99	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 01/19/90

CERTIFICATION HISTORY:

Date of Employment: 4 February 1980

Date of Initial Level I Certification: 13 October 1980

Date of Initial Level II Certification: 5 May 1982

Date of Most Recent Recertification: 3 March 1988

Date of Expiration: 3 March 1991

REMARKS:

SIGNED: James J. McAuller
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

01/19/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Eddie Escobedo

is qualified as Level II in MAGNETIC PARTICLE testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Sidney Lanier H.S., San Antonio, Texas, 1970.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 18 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	80.00	09/21/89
Specific	0.30	95.00	09/21/89
Practical	0.40	95.00	09/21/89
Composite		90.50	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 01/19/90

CERTIFICATION HISTORY:

Date of Employment: 4 February 1980

Date of Initial Level I Certification: 4 March 1981

Date of Initial Level II Certification: 23 August 1982

Date of Most Recent Recertification: 25 September 1989

Date of Expiration: 25 September 1992

REMARKS:

SIGNED: James J. McGuller
Responsible Level III

David Frank Rosson
Director, Department of NDE Services

01/19/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Eddie Escobedo

is qualified as Level II in VISUAL INSPECTION testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-2.

EDUCATION: Graduated Sidney Lanier H.S., San Antonio, Texas, 1970.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 27 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	85.00	09/03/87
Specific	0.33	92.00	09/03/87
Practical	0.33	100.00	09/03/87
Composite		92.33	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-2.

Correction Required: No   Date: 01/19/90

CERTIFICATION HISTORY:

Date of Employment: 4 February 1980

Date of Initial Level I Certification: 18 August 1980

Date of Initial Level II Certification: 23 August 1982

Date of Most Recent Recertification: 21 September 1987

Date of Expiration: 21 September 1990

REMARKS:

SIGNED: James J. McCullen
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

01/19/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Preston Gaines

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated Hondo H.S., Hondo, Texas, 1973.
Attended San Antonio College for 1 year.

TRAINING (For this certification): 246 hours.

EXPERIENCE (Initial certification): 9 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	80.20	07/20/88
Specific	0.30	86.80	07/20/88
Practical	0.40	93.50	07/20/88
Composite		87.50	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: No   **Date:** 04/06/90

CERTIFICATION HISTORY:

Date of Employment: 31 May 1976

Date of Initial Level I Certification: 21 June 1977

Date of Initial Level II Certification: 19 September 1979

Date of Most Recent Recertification: 1 August 1988

Date of Expiration: 1 August 1991

REMARKS: Inside Surface and Outside Surface Equipment Operator
Data Acquisition System Operator and Automated Data Analyst

SIGNED: Paul S. Sodium
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

04/06/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Preston Gaines

is qualified as Level II in LIQUID PENETRANT testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated Hondo H.S., Hondo, Texas, 1973.
Attended San Antonio College for 1 year.

TRAINING (For this certification): 12 hours.

EXPERIENCE (Initial certification): 2 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	84.50	01/23/90
Specific	0.30	95.00	01/23/90
Practical	0.40	100.00	01/24/90
Composite		93.85	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: No Date: 04/06/90

CERTIFICATION HISTORY:

Date of Employment: 31 May 1976

Date of Initial Level I Certification: 19 May 1980

Date of Initial Level II Certification: 29 January 1990

Date of Expiration: 29 January 1993

REMARKS: PT Device Operator
PT Data Analyst

SIGNED: Hector Diaz
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

04/09/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Preston Gaines

is qualified as Level ITR in MAGNETIC PARTICLE testing in accordance with the requirements of SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated Hondo H.S., Hondo, Texas, 1973.
Attended San Antonio College for 1 year.

TRAINING (For this certification): 4 hours.

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: No   Date: 04/06/90

CERTIFICATION HISTORY:

Date of Employment: 31 May 1976

Date of Initial Level ITR Certification: 18 March 1986

Date of Most Recent Recertification: 8 May 1989

Date of Expiration: 8 May 1992

REMARKS:

SIGNED: Carl A. Fodun
Responsible Level III

David Frank Brown
Director, Department of NDE Services

04/06/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Preston Gaines

is qualified as Level II in VISUAL testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated Hondo H.S., Hondo, Texas, 1973.
Attended San Antonio College for 1 year.

TRAINING (For this certification): 12 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	84.60	01/27/89
Specific	0.33	92.00	01/27/89
Practical	0.33	99.00	01/27/89
Composite		91.86	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: No Date: 04/06/90

CERTIFICATION HISTORY:

Date of Employment: 31 May 1976

Date of Initial Level I Certification: 25 September 1979

Date of Initial Level II Certification: 9 February 1989

Date of Expiration: 9 February 1992

REMARKS:

SIGNED: Jack A. Jodim
Responsible Level III

David Frank Brown
Director, Department of NDE Services

04/06/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of Engineering Services, Nondestructive Evaluation Science and Technology Division, certifies that Vincent K. Ganley is qualified as Level I Tr in Ultrasonic Testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1, which incorporates the guidelines of SNT-TC-1A, 1980 Edition.

Certification Limitations: Certification valid only while employed by SwRI

Special Qualifications (if any): None

Expiration Date: 02/02/92

Signed: _______ Date: 2/2/89

Director, Department of Engineering Services

EDUCATION, TRAINING, AND EXPERIENCE HISTORY

EDUCATION:	NAME	YEARS	DEGREE
High School	Bayside H.S. (Va.)	4	Grad
Additional:			
Major Field of Study			

TRAINING (This method and level):

Date Completed 01/31/89

Hours: 4 Location: SwRI

Date employed by SwRI: 10/19/87

The individual has been credited with N/A months of experience in this examination method on the date of certification. Some of the experience may have been accrued simultaneously with other NDE methods (at least 25% was in this method).

Previous NDE experience (if used for qualification):

COMPANY	FROM	TO
None		

VISUAL ACUITY AND COLOR PERCEPTION

The individual is capable of reading Jaeger Number 1 letters at 12 inches in at least one eye (using corrective lenses if specified below), and can distinguish and differentiate contrast between colors used in this method.

Date	Corr. Req.	Verified by	Date	Corr. Req.	Verified by
11/02/88	No	B. Huffman			
03/26/90	No	D. Autry			

MOST RECENT EXAMINATION GRADES

	SCORES	WEIGHT
General:	N/A	
Specific:	N/A	
Practical:	N/A	
Composite	N/A	

Date: N/A

Responsible Level III: N/A

CERTIFICATION HISTORY: THIS LEVEL

	DATE
Initial Certification:	02/02/89
Recertification:	
Recertification:	
Recertification:	
Recertification:	
Recertification:	
Recertification:	

REMARKS

SwRI Form QA-11-8

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Joel Hernandez

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Seguin H.S., Seguin, Texas, 1982.

TRAINING (For this certification): 54 hours.

EXPERIENCE (Initial certification): 13 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	83.33	01/17/89
Specific	0.30	85.00	01/26/89
Practical	0.40	90.00	01/27/89
Composite		86.50	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No   Date: 07/25/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 14 March 1988

Date of Initial Level II Certification: 26 July 1989

Date of Expiration: 26 July 1992

REMARKS:

SIGNED: James J. McClellan
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

11/07/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Joel Hernandez

is qualified as Level II in LIQUID PENETRANT testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Seguin H.S., Seguin, Texas, 1982.

TRAINING (For this certification): 21 hours.

EXPERIENCE (Initial certification): 4 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	85.00	06/16/89
Specific	0.30	86.67	06/16/89
Practical	0.40	84.00	06/22/89
Composite		85.10	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No   Date: 07/25/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 29 August 1989

Date of Expiration: 29 August 1992

REMARKS:

SIGNED: James D. McClellan
Responsible Level III

David Frank Rozow
Director, Department of NDE Services

08/29/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Joel Hernandez

is qualified as Level I in MAGNETIC PARTICLE testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Seguin H.S., Seguin, Texas, 1982.

TRAINING (For this certification): 18 hours.

EXPERIENCE (Initial certification): 2 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	87.50	02/10/89
Specific	0.30	100.00	02/10/89
Practical	0.40	93.00	02/10/89
Composite		93.45	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No   Date: 07/25/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 26 July 1989

Date of Expiration: 26 July 1992

REMARKS:

SIGNED: James L. McArdle
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

07/28/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Joel Hernandez

is qualified as Level I in VISUAL INSPECTION testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-2.

EDUCATION: Graduated Seguin H.S., Seguin, Texas, 1982.

TRAINING (For this certification): 24 hours.

EXPERIENCE (Initial certification): 4 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	96.66	02/02/89
Specific	0.33	85.00	02/02/89
Practical	0.33	83.75	02/02/89
Composite		88.40	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-2.

Correction Required: No **Date:** 07/25/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 8 February 1989

Date of Expiration: 8 February 1992

REMARKS:

SIGNED: James F. McArdle

Responsible Level III

David Frank Rosow

Director, Department of NDE Services

11/08/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

David Kleinjan

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1974.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 56 hours.

EXPERIENCE (Initial certification): 10 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	97.50	08/15/89
Specific	0.30	98.50	08/15/89
Practical	0.40	98.50	08/16/89
Composite		98.20	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 08/17/89

CERTIFICATION HISTORY:

Date of Employment: 14 August 1989

Date of Initial Level I Certification: 25 June 1986

Date of Initial Level II Certification: 8 September 1987

Date of Most Recent Recertification: 23 August 1989

Date of Expiration: 23 August 1992

REMARKS: EPRI IGSCC Qualifications - Manual Detection

SIGNED: James J. McArdle III
Responsible Level III

David Mark Rosow
Director, Department of NDE Services

01/17/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

David Kleinjan

is qualified as Level II in LIQUID PENETRANT testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1974.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 8 hours.

EXPERIENCE (Initial certification): 4 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	90.00	08/22/89
Specific	0.30	95.00	08/22/89
Practical	0.40	100.00	08/22/89
Composite		95.50	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 08/17/89

CERTIFICATION HISTORY:

Date of Employment: 14 August 1989

Date of Initial Level I Certification: 25 June 1986

Date of Initial Level II Certification: 14 December 1987

Date of Most Recent Recertification: 22 August 1989

Date of Expiration: 22 August 1992

REMARKS:

SIGNED: James J. McGuire III
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

09/19/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

David Kleinjan

is qualified as Level II in MAGNETIC PARTICLE testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1974.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 16 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	86.67	08/21/89
Specific	0.30	75.00	08/21/89
Practical	0.40	100.00	08/21/89
Composite		88.50	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 08/17/89

CERTIFICATION HISTORY:

Date of Employment: 14 August 1989

Date of Initial Level I Certification: 31 July 1986

Date of Initial Level II Certification: 28 January 1988

Date of Most Recent Recertification: 22 August 1989

Date of Expiration: 22 August 1992

REMARKS:

SIGNED: Francis J. McQuillen
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

09/19/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

David Kleinjan

is qualified as Level II in VISUAL INSPECTION testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-2.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1974.
Attended San Antonio College for 2 years.

TRAINING (For this certification): 14 hours.

EXPERIENCE (Initial certification): 4 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	91.43	08/25/89
Specific	0.33	95.00	08/25/89
Practical	0.33	100.00	08/25/89
Composite		95.48	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-2.

Correction Required: No　　Date: 08/17/89

CERTIFICATION HISTORY:

Date of Employment:	14 August 1989
Date of Initial Level I Certification:	31 July 1986
Date of Initial Level II Certification:	19 October 1987
Date of Most Recent Recertification:	25 August 1989
Date of Expiration:	25 August 1992

REMARKS:

SIGNED: James J. McArdle
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

09/19/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Simon Marin

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Edgewood H.S., San Antonio, Texas, 1956.

TRAINING (For this certification): 202 hours.

EXPERIENCE (Initial certification): 12 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	95.00	12/03/87
Specific	0.30	78.00	12/03/87
Practical	0.40	74.50	12/03/87
Composite		81.70	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: Yes Date: 01/31/90

CERTIFICATION HISTORY:

Date of Employment: 11 September 1964

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 1 September 1972

Date of Most Recent Recertification: 3 December 1987

Date of Expiration: 3 December 1990

REMARKS:

SIGNED: James J. McAuller
Responsible Level III

David Frank Rosson
Director, Department of NDE Services

01/31/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Simon Marin

is qualified as Level II in LIQUID PENETRANT testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Edgewood H.S., San Antonio, Texas, 1956.

TRAINING (For this certification): 22 hours.

EXPERIENCE (Initial certification): (See REMARKS)

TEST SCORES:

	Weight	Score	Date
General	0.30	83.50	08/30/88
Specific	0.30	80.00	08/30/88
Practical	0.40	88.00	08/30/88
Composite		84.30	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: Yes   Date: 01/31/90

CERTIFICATION HISTORY:

Date of Employment: 11 September 1964

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 11 April 1975

Date of Most Recent Recertification: 9 September 1988

Date of Expiration: 9 September 1991

REMARKS: Certified to Level II with at least 3 months experience.

SIGNED: James M. Cullen
Responsible Level III

David Frank Brown
Director, Department of NDE Services

01/31/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Simon Marin

is qualified as Level II in MAGNETIC PARTICLE testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Edgewood H.S., San Antonio, Texas, 1956.

TRAINING (For this certification): 32 hours.

EXPERIENCE (Initial certification): 8 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	80.00	06/06/89
Specific	0.30	85.00	06/06/89
Practical	0.40	85.00	06/06/89
Composite		83.50	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: Yes   Date: 01/31/90

CERTIFICATION HISTORY:

Date of Employment: 11 September 1964

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 24 July 1989

Date of Expiration: 24 July 1992

REMARKS:

SIGNED: James J. McClellan
Responsible Level III

David Frank Rosa
Director, Department of NDE Services

01/31/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Simon Marin

is qualified as Level II in VISUAL testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-2.

EDUCATION: Graduated Edgewood H.S., San Antonio, Texas, 1956.

TRAINING (For this certification): 37 hours.

EXPERIENCE (Initial certification): 14 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	85.00	09/10/87
Specific	0.33	92.00	09/10/87
Practical	0.33	88.00	09/11/87
Composite		88.32	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-2.

Correction Required: Yes Date: 01/31/90

CERTIFICATION HISTORY:

Date of Employment: 11 September 1964

Date of Initial Level I Certification: N/A

Date of Initial Level II Certification: 6 November 1985

Date of Most Recent Recertification: 14 September 1987

Date of Expiration: 14 September 1990

REMARKS:

SIGNED: James M. McCullough
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

01/31/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Cherie Rhoad

is qualified as Level ITR in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1971.

TRAINING (For this certification): 4 hours.

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: Yes   Date: 03/02/90

CERTIFICATION HISTORY:

Date of Employment: 25 March 1980

Date of Initial Level ITR Certification: 14 March 1989

Date of Expiration: 14 March 1992

REMARKS:

SIGNED: ______________________
Responsible Level III

____
Director, Department of NDE Services

03/05/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Cherie Rhoad

is qualified as Level ITR in LIQUID PENETRANT testing in accordance with the requirements of SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1971.

TRAINING (For this certification): 4 hours.

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: Yes Date: 03/02/90

CERTIFICATION HISTORY:

Date of Employment: 25 March 1980

Date of Initial Level ITR Certification: 13 March 1989

Date of Expiration: 13 March 1992

REMARKS:

SIGNED: Jack A. Fodum
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

03/05/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Cherie Rhoad

is qualified as Level ITR in MAGNETIC PARTICLE testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1971.

TRAINING (For this certification): 4 hours.

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: Yes   Date: 03/02/90

CERTIFICATION HISTORY:

Date of Employment:	25 March 1980
Date of Initial Level ITR Certification:	13 March 1989
Date of Expiration:	13 March 1992

REMARKS:

SIGNED: Paul A. Fodum
Responsible Level III

David Frank Rozon
Director, Department of NDE Services

03/05/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Cherie Rhoad

is qualified as Level ITR in VISUAL testing in accordance with the requirements of SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated John Jay H.S., San Antonio, Texas, 1971.

TRAINING (For this certification): 4 hours.

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: Yes Date: 03/02/90

CERTIFICATION HISTORY:

Date of Employment:	25 March 1980
Date of Initial Level ITR Certification:	14 March 1989
Date of Expiration:	14 March 1992

REMARKS:

SIGNED: Jael S. Fordin
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

03/05/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Barbara Roberds

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Mason H.S., Mason, Texas, 1956.

TRAINING (For this certification): 178 hours.

EXPERIENCE (Initial certification): 15 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	87.50	05/30/89
Specific	0.30	83.65	05/30/89
Practical	0.40	95.50	05/31/89
Composite		89.55	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: Yes Date: 08/03/89

CERTIFICATION HISTORY:

Date of Employment: 12 January 1981

Date of Initial Level I Certification: 28 September 1981

Date of Initial Level II Certification: 13 July 1983

Date of Most Recent Recertification: 16 June 1989

Date of Expiration: 16 June 1992

REMARKS: EPRI IGSCC Qualifications - Manual Detection
- Manual Overlay

SIGNED: James L. McClellan III
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

01/31/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Barbara Roberds

is qualified as Level II in LIQUID PENETRANT testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Mason H.S., Mason, Texas, 1956.

TRAINING (For this certification): 26 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	96.70	07/07/89
Specific	0.30	100.00	07/07/89
Practical	0.40	100.00	07/08/89
Composite		99.01	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: Yes Date: 08/03/89

CERTIFICATION HISTORY:

Date of Employment:	12 January 1981
Date of Initial Level I Certification:	12 November 1981
Date of Initial Level II Certification:	28 October 1983
Date of Most Recent Recertification:	2 August 1989
Date of Expiration:	2 August 1992

REMARKS:

SIGNED: Jamie J. McCullen
Responsible Level III

Grady C. Tagleder for OFR
Director, Department of NDE Services

09/26/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Barbara Roberds

is qualified as Level II in MAGNETIC PARTICLE testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated Mason H.S., Mason, Texas, 1956.

TRAINING (For this certification): 24 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	96.70	02/01/90
Specific	0.30	85.00	02/01/90
Practical	0.40	100.00	02/05/90
Composite		94.51	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: Yes Date: 08/03/89

CERTIFICATION HISTORY:

Date of Employment: 12 January 1981

Date of Initial Level I Certification: 16 July 1982

Date of Initial Level II Certification: 3 February 1984

Date of Most Recent Recertification: 7 February 1990

Date of Expiration: 7 February 1993

REMARKS:

SIGNED: Joel A. Jodin
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

02 07 9?

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Barbara Roberds

is qualified as Level II in VISUAL INSPECTION testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-2.

EDUCATION: Graduated Mason H.S., Mason, Texas, 1956.

TRAINING (For this certification): 22 hours.

EXPERIENCE (Initial certification): 4 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	82.50	09/10/87
Specific	0.33	92.00	09/10/87
Practical	0.33	84.50	09/11/87
Composite		86.29	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-2.

Correction Required: Yes Date: 08/03/89

CERTIFICATION HISTORY:

Date of Employment: 12 January 1981

Date of Initial Level I Certification: 24 May 1982

Date of Initial Level II Certification: 23 August 1984

Date of Most Recent Recertification: 28 September 1987

Date of Expiration: 28 September 1990

REMARKS:

SIGNED: James Q. McArdle III
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

08/04/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Mark Warzyniak

is qualified as Level II in ULTRASONIC testing
in accordance with the requirements of
SwRI Nuclear Projects Operating Procedure 2.0-NDES-101.

EDUCATION: Graduated Del Rio H.S., Del Rio, Texas, 1978.
Graduated Texas State Tech. Inst..

TRAINING (For this certification): 54 hours.

EXPERIENCE (Initial certification): 11 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	88.10	01/17/89
Specific	0.30	86.00	01/17/89
Practical	0.40	82.00	01/17/89
Composite		85.03	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Projects Operating Procedure 2.0-NDES-101.

Correction Required: No   Date: 08/02/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 6 April 1988

Date of Initial Level II Certification: 8 May 1989

Date of Expiration: 8 May 1992

REMARKS: EPRI IGSCC Qualifications - Manual Detection

SIGNED: Jack A. Jordin
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

03/20/90

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Mark Warzyniak

is qualified as Level II in LIQUID PENETRANT testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Del Rio H.S., Del Rio, Texas, 1978.
Graduated Texas State Tech. Inst..

TRAINING (For this certification): 15 hours.

EXPERIENCE (Initial certification): 3 months.

TEST SCORES:

	Weight	Score	Date
General	0.30	86.67	06/16/89
Specific	0.30	75.00	06/16/89
Practical	0.40	99.00	06/19/89
Composite		88.10	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No Date: 08/02/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 14 October 1988

Date of Initial Level II Certification: 29 August 1989

Date of Expiration: 29 August 1992

REMARKS:

SIGNED: James J. McGillis
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

10/03/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Mark Warzyniak

is qualified as Level I in MAGNETIC PARTICLE testing in accordance with the requirements of SwRI Nuclear Quality Assurance Procedure 11-1.

EDUCATION: Graduated Del Rio H.S., Del Rio, Texas, 1978.
Graduated Texas State Tech. Inst..

TRAINING (For this certification): 18 hours.

EXPERIENCE (Initial certification): 1 month.

TEST SCORES:

	Weight	Score	Date
General	0.30	92.50	02/10/89
Specific	0.30	87.50	02/10/89
Practical	0.40	96.00	02/10/89
Composite		92.40	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-1.

Correction Required: No   Date: 08/02/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 24 July 1989

Date of Expiration: 24 July 1992

REMARKS:

SIGNED: James F. McArdle III
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

10/03/89

Form QA-68-0

SOUTHWEST RESEARCH INSTITUTE
NONDESTRUCTIVE EXAMINATION
STATEMENT OF CERTIFICATION

The Director of the Department of NDE Services certifies that

Mark Warzyniak

is qualified as Level II in VISUAL testing
in accordance with the requirements of
SwRI Nuclear Quality Assurance Procedure 11-2.

EDUCATION: Graduated Del Rio H.S., Del Rio, Texas, 1978.
Graduated Texas State Tech. Inst..

TRAINING (For this certification): 14 hours.

EXPERIENCE (Initial certification): 5 months.

TEST SCORES:

	Weight	Score	Date
General	0.33	80.00	01/26/90
Specific	0.33	80.00	01/26/90
Practical	0.33	95.00	01/29/90
Composite		85.00	

VISUAL ACUITY AND COLOR PERCEPTION: This individual has been tested for visual acuity and color perception in accordance with Nuclear Quality Assurance Procedure 11-2.

Correction Required: No Date: 08/02/89

CERTIFICATION HISTORY:

Date of Employment: 8 June 1987

Date of Initial Level I Certification: 8 February 1989

Date of Initial Level II Certification: 29 January 1990

Date of Expiration: 29 January 1993

REMARKS:

SIGNED: James T. McCardlish
Responsible Level III

David Frank Rosow
Director, Department of NDE Services

01/29/90

Form QA-68-0

APPENDIX F

MATERIAL AND EQUIPMENT CERTIFICATIONS

APPENDIX F

MATERIAL AND EQUIPMENT CERTIFICATIONS

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APPENDIX F

MATERIAL AND EQUIPMENT CERTIFICATIONS

Table of Contents (Cont'd)

TRANSDUCERS

SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111 • TELEX 244846

February 26, 1990

Mr. J. H. Wilson
Quality Assurance Systems &
Engineering
Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238

Dear Sir:

The Chemical analysis that you requested on two marking pencils has been completed. The results are as follows:

Code	Sulfur, % wt. (ASTM D-129)	Halogens, % wt. (ASTM D-808)
Berol Prismacolor White 935	0.04	0.11
Berol Prismacolor Black 935	0.09	0.28

If you have any questions concerning these test results, please contact me.

Sincerely,

Ralph W. Bowen

Ralph W. Bowen, Principal Scientist
Petroleum Products Research Department
Automotive Products & Emissions Research

ygc

SwRI
P. O. 14765
P. R. 007950
LOG 2896

SAN ANTONIO, TEXAS
DALLAS / FT WORTH, TEXAS • HOUSTON, TEXAS • DETROIT, MICHIGAN • WASHINGTON, DC

SOUTHWEST RESEARCH INSTITUTE
POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111 • TELEX 244846

February 26, 1990

Mr. J. H. Wilson
Quality Assurance Systems &
Engineering
Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238

Dear Sir:

The Chemical analysis that you requested on two marking pencils has been completed. The results are as follows:

Code	Sulfur, % wt. (ASTM D-129)	Halogens, % wt. (ASTM D-808)
Berol Prismacolor White 935	0.04	0.11
Berol Prismacolor Black 935	0.09	0.28

If you have any questions concerning these test results, please contact me.

Sincerely,

Ralph W. Bowen

Ralph W. Bowen, Principal Scientist
Petroleum Products Research Department
Automotive Products & Emissions Research

ygc

SwRI
P. O. 94660
P. R. 005504
LOG 2749

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SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111 • TELEX 244846

January 12, 1990

Mr. J.H. Wilson
Quality Assurance Systems &
Engineering
Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238

Dear Sir:

The chemical analysis that you requested on one sample of Glycerine has been completed. The results are as follows:

Code:	Log #2746 Lot #TA870731-04 Run #1	Run #2
Sulfur, % wt. (X-ray)	0.004	0.003
Total Halogens, % wt. (X-ray)	0.004	0.004

If you have any questions concerning these test results, please contact me.

Sincerely,

Ralph W. Bowen

Ralph W. Bowen, Principal Scientist
Petroleum Products Research Dept.
Automotive Products & Emissions Res.

rla

SwRI
P. O. 94577
P. R. 005461
LOG 2746

SAN ANTONIO, TEXAS
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CERTIFICATE OF ANALYSIS

DOW CHEMICAL U.S.A.

GLYCERINE, USP, 99.5%

DATE 2-10-89

Customer Name and Address	VAN WATERS & ROGERS	Dow Invoice No.	
	ATTN: PETE	Customer Order No.	
	SAN ANTONIO TX	Date Shipped	

Carrier

Shipping Point Freeport TX

Lot No. TB 870731-04

94507

P. R. 005461

2746

Note: On tank car shipments, car number is Lot No.

Description: clear viscous, hygroscopic liquid. Sweet taste. No more than slight characteristic odor.

I CERTIFY THAT THE ABOVE MATERIAL MEETS THE REQUIREMENTS OF THE U.S. PHARMACOPEIA AND DOW SPECIFICATION AS LISTED BELOW:

TEST	LIMITS	TEST RESULTS
SP. GR., 25/25°C	1.2607 MIN.	1.2618
*ASSAY FROM SPECIFIC GRAVITY	99.5% MIN.	99.9
COLOR, APHA	10 MAX.	2
*RESIDUE ON IGNITION	0.005% MAX.	<.002%
CHLORIDE	NONE DETECTED	conforms
SULFATE	20 PPM MAX.	passes test
*ARSENIC (as As)	1.5 PPM MAX.	conforms
*HEAVY METALS (as Pb)	5 PPM MAX.	passes test
READILY CARBONIZABLE SUBSTANCES	PASSES	passes test
*CHLORINATED COMPOUNDS (as Cl)	0.0005% MAX.	passes test
ACROLEIN, GLUCOSE & NH_4 CMPDS.	PASSES	conforms
FATTY ACIDS AND ESTERS	0.2 MEQ/100g MAX.	.05 meq/100g
WATER	0.5% MAX.	.028
*ASSAY, PERIODATE OXIDATION	98.0% - 101.0%	conforms

*THESE TESTS ARE CERTIFIED BY ANALYSIS OF MONTHLY COMPOSITES AND ARE NOT NORMALLY MADE ON INDIVIDUAL SHIPMENTS.

BY T. R. Rice

LABORATORY SUPERVISOR

MAGNAFLUX®

Date: May 18, 1989

Purchase Order No. 31473

SUBJECT: Spotcheck Cleaner/Remover Type: SKC-S Batch No. 89E03K

We hereby certify that when tested at the time of manufacture, the above material:

1. Meets the requirements of and has been tested for sulfur and halogens according to:
   - (a) ASME Boiler and Pressure Vessel Code, 1983 Edition, Section V, Nondestructive Examination, including all Addenda through Winter 1983 Addendum, Paragraph T-625 and Article 24 as applicable.
   - (b) ASME Boiler and Pressure Vessel Code, 1986 Edition, Section V, Nondestructive Examination, Paragraph T-625 and Article 24 as applicable.
   - (c) ASTM E-165-80, Paragraph 7.1.
   - (d) NAVSEA 250-1500-1 (Rev. 10 June 1979 and Rev. 11 May 1983) Paragraphs 12.8.1.1 and 12.5.1.1.1.
   - (e) MIL-STD-271F(SH), 27 June 1986, Paragraphs 5.3 and 5.3.1.
   - (f) MIL-STD-2132A(SH), 15 March 1985, Paragraphs 7.1.1, 7.1.2, and 7.1.3 and Appendix C, Paragraph 30.

The following test results were obtained:

Sulfur: NA wt. % of residue. Halogen: NA wt. % of residue

Cleaner residue (see Note 3) 0.0034 g/100g. 0.0026 g/100 ml.

2. We further certify that this material does not contain mercury as a basic element, and no mercury bearing equipment was used in its manufacture.

MAGNAFLUX CORPORATION

Cheri A. Zeleznik

~~M. Piamonttil - Manager, Quality Assurance~~

Cheri A. Zaleznik-Project Manager

NOTES:
1. Our batch number appears on the bottom of all aerosol cans and on the label of all bulk containers.
2. Most specifications require test results stated in percent but some require parts per million (ppm). To convert "percent" figures to "parts per million" move the decimal four places to the right.
3. NAVSEA 250-1500-1, MIL-STD-271, MIL-STD-2132, and ASME Section V all require that materials be subject to a procedure to evaporate off volatile solvents before analysis for sulfur and halogen. According to these specifications, only those residues higher than 0.005 g/100 ml shall be analyzed for sulfur and halogen. Lower residues shall be reported.
4. The above certification gives the results obtained at the time of manufacture. Age and use may alter the properties of any material.

SwRI
P. O. 31473
P. R. 683524
LOG 2910

Form No. 1589 R-1/89

MAGNAFLUX A Division of Illinois Tool Works Inc
306 Industrial Street | P.O. Box 366 | Dewitt Iowa 52742 | Telephone: 319-659-8143 | Fax 319-659-9713

MAGNAFLUX Corporation 7300 West Lawrence Avenue | Chicago, IL 60656 | Telephone 312-867-8000
FAX 312-867-6833

MAGNAFLUX

Date: February 15, 1989

Wemi
P. O. 02795
P. R. 006510
LOG ~~MU~~ ~~887~~
4831

Purchase Order No. ______

SUBJECT: Spotcheck Penetrant Type: SKL-HF Batch No. 89A059

We hereby certify that when tested at the time of manufacture, the above material:

1. Meets the requirements of and has been tested for sulfur and halogens according to:
   (a) ASME Boiler and Pressure Vessel Code, 1983 Edition, Section V, Nondestructive Examination, including all Addenda through Winter 1983 Addendum, Paragraph T-625 and Article 24 as applicable.
   (b) ASME Boiler and Pressure Vessel Code, 1986 Edition, Section V, Nondestructive Examination, Paragraph T-625 and Article 24 as applicable.
   (c) ASTM E-165-80, Paragraph 7.1.
   (d) NAVSEA 250-1500-1 (Rev. 10 June 1979 and Rev. 11 May 1983) Paragraphs 12.5.1.1 and 12.5.1.1.1.
   (e) MIL-STD-271F(SH), 27 June 1986, Paragraphs 5.3 and 5.3.1.
   (f) MIL-STD-2132A(SH), 15 March 1985, Paragraphs 7.1.1, 7.1.2, and 7.1.3 and Appendix C, Paragraph 30.

The following test results were obtained:

Sulfur: 0.0094 wt. % of residue. Halogen: 0.0022 wt. % of residue

Cleaner residue (see Note 3) NA g/100g. NA g/100 ml.

2. We further certify that this material does not contain mercury as a basic element, and no mercury bearing equipment was used in its manufacture.

MAGNAFLUX CORPORATION

M. Plamoottil

M. Plamoottil - Manager, Quality Assurance

NOTES:
1. Our batch number appears on the bottom of all aerosol cans and on the label of all bulk containers.
2. Most specifications require test results stated in percent but some require parts per million (ppm). To convert "percent" figures to "parts per million" move the decimal four places to the right.
3. NAVSEA 250-1500-1, MIL-STD-271, MIL-STD-2132, and ASME Section V all require that materials be subject to a procedure to evaporate off volatile solvents before analysis for sulfur and halogen. According to these specifications, only those residues higher than 0.005 g/100 ml shall be analyzed for sulfur and halogen. Lower residues shall be reported.
4. The above certification gives the results obtained at the time of manufacture. Age and use may alter the properties of any material.

Form No. 1569 R-1/89

MAGNAFLUX Corporation , 7300 West Lawrence Avenue Chicago, IL 60656 Telephone 312-867-8000

MAGNAFLUX

Date: February 4, 1988

Purchase Order/Contract No. ____________

We hereby certify that the Spotcheck Developer, Type SKD-S,
Batch No. 88A072, supplied meets the requirements of MIL-I-25135D, and is approved by the U.S. Air Force.

When tested according to paragraph 4.4.1.2., Sampling Plan A, the following results were obtained:

(a)	Flash Point (PMCT), 4.5.3	< 30.0	°F
(b)	Viscosity, (______ cs Nominal), 4.5.4	NA cs	0°F
(c)	Developer Fluorescence, 4.5.14	Passes	
(d)	Water Content, 4.5.20	NA	%
(e)	Penetrant Removability, 4.5.16 (______ Standard)	NA	
(f)	Water Tolerance, 4.5.12	NA	%
(g)	Fluorescent Brightness of Penetrants, 4.5.7 (______ Standard)	NA	%
(h)	Surface Wetting, 4.5.8	NA	
(i)	Thermal Stability, 4.5.9 (______ Standard)	NA	%
(j)	Redispersibility, 4.5.13	Passes	

We further certify that this material meets the requirements of MIL-STD-6866 (30 September 1985), Paragraph 4.4.1 and where applicable, 5.8.4.

MAGNAFLUX CORPORATION

A. J. Britton

A. S. Britton - Manager, Quality Assurance
M. J. Plamoottil - Quality Control Chemist

Form No. 1579A
Rev 1/88

Sw
P. O. 51392
P. R. 548541
LOG 2497

MAGNAFLUX : 7300 West Lawrence Avenue | Chicago, IL 60656 ; Telephone: 312-867-8000
TELEX: 277658 MAGX UR
FAX: 312-867-6633

MAGNAFLUX

Date: June 2, 1989

Purchase Order No. ____________

SUBJECT: Spotcheck Developer Type: SKD-S Batch No. 89E09K

We hereby certify that when tested at the time of manufacture, the above material:

1. Meets the requirements of and has been tested for sulfur and halogens according to:
   - (a) ASME Boiler and Pressure Vessel Code, 1983 Edition, Section V, Nondestructive Examination, including all Addenda through Winter 1983 Addendum, Paragraph T-625 and Article 24 as applicable.
   - (b) ASME Boiler and Pressure Vessel Code, 1986 Edition, Section V, Nondestructive Examination, Paragraph T-625 and Article 24 as applicable.
   - (c) ASTM E-165-80, Paragraph 7.1.
   - (d)* NAVSEA 250-1500-1 (Rev. 10 June 1979 and Rev. 11 May 1983) Paragraphs 12.5.1.1 and 12.5.1.1.1.
   - (e) MIL-STD-271F(SH), 27 June 1986, Paragraphs 5.3 and 5.3.1.
   - (f) MIL-STD-2132A(SH), 15 March 1985, Paragraphs 7.1.1, 7.1.2, and 7.1.3 and Appendix C, Paragraph 30.

The following test results were obtained:

Sulfur: 0.0548 wt. % of residue.* Halogen: 0.0233 wt. % of residue

Cleaner residue (see Note 3) NA g/100g. NA g/100 ml.

2. We further certify that this material does not contain mercury as a basic element, and no mercury bearing equipment was used in its manufacture.

MAGNAFLUX CORPORATION

Cheri A Zeleznik

M. Plamoottil - Manager, Quality Assurance

Cheri A. Zeleznik-Project Manager

NOTES:
1. Our batch number appears on the bottom of all aerosol cans and on the label of all bulk containers.
2. Most specifications require test results stated in percent but some require parts per million (ppm). To convert "percent" figures to "parts per million" move the decimal four places to the right.
3. NAVSEA 250-1500-1, MIL-STD-271, MIL-STD-2132, and ASME Section V all require that materials be subject to a procedure to evaporate off volatile solvents before analysis for sulfur and halogen. According to these specifications, only those residues higher than 0.005 g/100 ml shall be analyzed for sulfur and halogen. Lower residues shall be reported.
4. The above certification gives the results obtained at the time of manufacture. Age and use may alter the properties of any material.

SwRI
P. O. 04190
P. R. 006776
LOG 2872

Form No. 1569 R-1/89

MAGNAFLUX, a Division of Illinois Tool Works, Inc.

MAGNAFLUX

Date: May 5, 1989

TO:

Purchase Order No. ______

We hereby certify that the Magnetic Particle Inspection Material type No. 1 Gray Powder, Batch No. 890086

meets the requirements of the following specifications:

A. ASME Boiler and Pressure Vessel Code, Section V, 1986 Edition, Nondestructive Examination, Paragraphs T-723, T-726(A) and Article 25 as applicable.

B. ASTM E 709-80, Paragraphs 6.1, 6.2, and 6.3.

C. NAVSEA 250-1500-1, Rev. 10 June 1979 and Rev. 11, May 1983, Paragraph 12.4.1.6.

D. MIL-STD-1949, 1 August 1985 Paragraphs 4.10.1 and 4.10.1.1.

E. MIL-STD-271F(SH), 27 June 1986, Paragraphs 4.2.7, 4.3.2.3, and 4.3.3.1.

F. MIL-STD-2132A(SH), 15 March 1985, Paragraph 6.2.1.3.

We further certify that this material does not contain mercury as a basic element and no mercury bearing equipment was used in its manufacture.

Batch numbers appear on labels of bulk containers.

3xRI
P. O. 16884
P. R. 008174
LOG 2924

MAGNAFLUX CORPORATION

Cheri a Zeleznik

M. Plamoottil - Manager, Quality Assurance
Cheri A. Zeleznik-Project Manager

Form No. 1565A R-1/89

7300 West Lawrence Avenue | Chicago, Illinois 60656

MAGNAFLUX Corporation 7300 West Lawrence Avenue Chicago IL 60656 Telephone 312-867-3000

MAGNAFLUX

Date: January 8, 1986

TO:

Purchase Order No. 92254

We hereby certify that the Magnetic Particle Inspection Material type No. 1 Gray Powder, Batch No. 85K011 meets the requirements of the following specifications:

A. ASME Boiler and Pressure Vessel Code, Section V, 1983 Edition, Nondestructive Examination, with Addenda through Winter, 1985, Paragraphs T-723, T-726(a) and Article 25.

B. ASTM E 709-80, Paragraphs 6.1, 6.2, and 6.3.

C. NAVSEA 250-1500-1, Rev. 10 June 1979 and Rev. 11, May 1983, Paragraph 12.4.1.6.

D. MIL-STD-1949, 1 August 1985 Paragraph 4.10.1 and 4.10.1.1.

E. MIL-STD-271E(SHIPS), ACN-1, 24 October 1980, Paragraphs 4.2.6, 4.3.2.3, and 4.3.3.1. and ACN-2, 1 May 1984.

F. MIL-STD-271E(SHIPS), NTR-1E, 16 June 1978, Paragraph 4.3.2.3.

G. MIL-STD-2132(SH), 16 January, 1981, Paragraph 4.2.1.3 and Appendix A, Paragragh 50.4.

We further certify that this material does not contain mercury as a basic element and no mercury bearing equipment was used in its manufacture.

Batch numbers appear on labels of bulk containers.

SWRI
P.O. 92254
P.R. 374092
LOG 22154

MAGNAFLUX CORPORATION

A. S. Britton
Manager, Quality Control and Quality Assurance
T. E. Regan - Certification Clerk

Form No. 1565A R-12/85

MAGNAFLUX Corporation 7300 West Lawrence Avenue Chicago, IL 60656 Telephone 312-867-8000

MAGNAFLUX

Date: ~~April 11, 1986~~

TO:

Purchase Order No. __________

We hereby certify that the Magnetic Particle Inspection Material type No. 8A Red Powder, Batch No. 86C085 meets the requirements of the following specifications:

A. ASME Boiler and Pressure Vessel Code, Section V, 1983 Edition, Nondestructive Examination, with Addenda through Winter, 1985, Paragraphs T-723, T-726(a) and Article 25.

B. ASTM E 709-80, Paragraphs 6.1, 6.2, and 6.3.

C. NAVSEA 250-1500-1, Rev. 10 June 1979 and Rev. 11, May 1983, Paragraph 12.4.1.6.

D. MIL-STD-1949, 1 August 1985 Paragraph 4.10.1 and 4.10.1.1.

E. MIL-STD-271E(SHIPS), ACN-1, 24 October 1980, Paragraphs 4.2.6, 4.3.2.3, and 4.3.3.1. and ACN-2, 1 May 1984.

F. MIL-STD-271E(SHIPS), NTR-1E, 16 June 1978, Paragraph 4.3.2.3.

G. MIL-STD-2132(SH), 16 January, 1981, Paragraph 4.2.1.3 and Appendix A, Paragragh 50.4.

We further certify that this material does not contain mercury as a basic element and no mercury bearing equipment was used in its manufacture.

Batch numbers appear on labels of bulk containers.

SARI
P.O 92254
P. 374092
LOG 2215 B

MAGNAFLUX CORPORATION

A. S. Britton
Manager, Quality Control and Quality Assurance
T. E. Regan - Certification Clerk

Form No. 1565A R-12/85

PR #69435

SOUTHWEST RESEARCH INSTITUTE

CERTIFICATE OF COMPLIANCE

SwRI
P. O. 39377sw
P. R. 69435
LCG 0676

SwRI Purchase Order No. 39377 Date 8/17/77

Southwest Photo Supplies (Supplier's Name) certifies the following with respect to the above purchase order:

(1) That the articles delivered under the above SwRI Purchase Order Item No.(s) 39377SW comply fully with the requirements specified therein.

That the above supplier agrees to maintain and preserve records of evidence of compliance with SwRI requirements for three (3) years from the date of final payment. These records shall include any documentation required to substantiate statements made on this form and shall be made available for review upon request of SwRI or its designated representative.

Signed: Richard R Myers
(Duly Authorized Supplier's Representative

Title: Sales Man Date: 8/20/77

SwRI Form QA-36-0

SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111 • TELEX 76-7357

Division 05 – Instrument Repair and Calibration Laboratory

Calibration Record

ITEM AMPROBE FASTEMP

MODEL T-150 S/N 830350 SWRI NO. Ø81

PLUG-INS, ETC. PROBE # Ø81

TOLERANCE ± 3°F OF STANDARD INDICATION.

STANDARDS

Standard No.	MFGR Model	Description	S/N	Cal. Due	Cal. Rec. No.
	15-041B	THERMOMETER	691-2261	10 FEB 92	04232

ENVIRONMENT: Temperature 71°F Humidity 45%

Location ROOM A11, BLDG 68, SWRI

PROCEDURE

☐ Essentially as outlined in MFGRS Service Manual

☒ SWRI NUCLEAR PROJECTS OPERATING PROCEDURE 12.0-NDES-102:

"STANDARD READING"	"AMPROBE READING"	
7[illegible].3°F	76.[illegible]	READING AT ROOM TEMP AFTER 1 HR.
43.5°F	75.[illegible]	READING AT LOW END OF SCALE
105.0°F	106.[illegible]	READING AT MID SCALE
134.6°F	134.[illegible]	READING AT HIGH END OF SCA.

CONCLUSION (LIMITED CALIBRATION, HIGH RANGE ONL

☐ Item within tolerance

☐ Item out of tolerance

☐ Item ADJ/repaired to tolerance

☒ ITEM WITHIN LIMITS OF ABOVE PROCEDURE-

Calibration was in accord with requirements of MIL-STD-45662A, MIL-Q-9858A, and MIL-I-45208A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

SIGNED [signature]

DATE 19 APRIL 90

RECORD NUMBER: 0005377 NEXT CALIBRATION DUE: 19 OCT 90

SOUTHWEST RESEARCH INSTITUTE

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Division 05 – Instrument Repair and Calibration Laboratory

Calibration Record

ITEM AMPROBE FASTEMP

MODEL T-150 S/N 420253 SWRI NO. 112

PLUG-INS, ETC. PROBE #112

TOLERANCE ± 3°F OF STANDARD INDICATION.

STANDARDS

Standard No.	MFGR Model	Description	S/N	Cal. Due	Cal. Rec. No.
15-041B		THERMOMETER	871-2261	18AUG92	04232

ENVIRONMENT: Temperature 72°F Humidity 45%

Location ROOM A11, BLDG 68, SWRI

PROCEDURE

☐ Essentially as outlined in MFGRS Service Manual

☒ SWRI NUCLEAR PROJECTS OPERATING PROCEDURE 12.0-NDES-102:

"STANDARD READING"	"AMPROBE READING"	
44.4°F	44°F	READING AT ROOM TEMP AFTER 1 HR. ST.
93.9°F	94°F	READING AT LOW END OF SCALE
140.0°F	142°F	READING AT MID SCALE
72.8°F	71°F	READING AT HIGH END OF SCALE

CONCLUSION (LIMITED CALIBRATION, HIGH RANGE ONLY)

☐ Item within tolerance

☐ Item out of tolerance

☐ Item ADJ/repaired to tolerance

☒ ITEM WITHIN LIMITS OF ABOVE PROCEDURE.

Calibration was in accord with requirements of MIL-STD-45662A, MIL-Q-9858A, and MIL-I-45208A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

SIGNED [signature]

DATE 14FEB90

RECORD NUMBER: 0005182 NEXT CALIBRATION DUE: 14AUG90

SOUTHWEST RESEARCH INSTITUTE

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Division 05 – Instrument Repair and Calibration Laboratory

Calibration Record

ITEM AMPROBE FASTEMP

MODEL T-150 S/N 420050 SWRI NO. 113

PLUG-INS, ETC. PROBE # 113

TOLERANCE ± 3°F OF STANDARD INDICATION.

STANDARDS

Standard No.	MFGR Model	Description	S/N	Cal. Due	Cal. Rec. No.
15-041B		THERMOMETER	891-2261	10AUG92	04232

ENVIRONMENT: Temperature 72°F Humidity 45%

Location ROOM A11, BLDG 68, SWRI

PROCEDURE

☐ Essentially as outlined in MFGRS Service Manual

☒ SWRI NUCLEAR PROJECTS OPERATING PROCEDURE 12.0-NDES-102:

"STANDARD READING"	"AMPROBE READING"	
47.4°F	46°F	READING AT ROOM TEMP AFTER 1 MIN. ST.
93.2°F	96°F	READING AT LOW END OF SCALE
140.6°F	142°F	READING AT MID SCALE
72.5°F	74°F	READING AT HIGH END OF SCALE

CONCLUSION (LIMITED CALIBRATION, HIGH RANGE ONLY)

☐ Item within tolerance

☐ Item out of tolerance

☐ Item ADJ/repaired to tolerance

☒ ITEM WITHIN LIMITS OF ABOVE PROCEDURE.

Calibration was in accord with requirements of MIL-STD-45662A, MIL-Q-9858A, and MIL-I-45208A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

SIGNED [signature]

DATE 14 FEB 90

RECORD NUMBER: 0005179 NEXT CALIBRATION DUE: 14 AUG 90

SOUTHWEST RESEARCH INSTITUTE

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Division 05 – Instrument Repair and Calibration Laboratory

Calibration Record

ITEM AMPROBE FASTEMP

MODEL T-150 S/N 510685 SWRI NO. 141

PLUG-INS, ETC. PROBE # 141

TOLERANCE ± 3°F OF STANDARD INDICATION.

STANDARDS

Standard No.	MFGR Model	Description	S/N	Cal. Due	Cal. Rec. No.
15-041B		THERMOMETER	891-2261	10APR92	04232

ENVIRONMENT: Temperature 72°F Humidity 43%

Location ROOM A11, BLDG 68, SWRI

PROCEDURE

☐ Essentially as outlined in MFGRS Service Manual

☒ SWRI NUCLEAR PROJECTS OPERATING PROCEDURE 12.0-NDES-102:

"STANDARD READING"	"AMPROBE READING"	
44.4°F	46°F	READING AT ROOM TEMP [illegible]
93.9°F	94°F	READING AT LOW END OF SCALE
110.0°F	129°F	READING AT MID SCALE
72.8°F	74°F	READING AT HIGH END OF SCALE

CONCLUSION (LIMITED CALIBRATION, HIGH RANGE ONLY)

☐ Item within tolerance

☐ Item out of tolerance

☐ Item ADJ/repaired to tolerance

☒ ITEM WITHIN LIMITS OF ABOVE PROCEDURE-

Calibration was in accord with requirements of MIL-STD-45662A, MIL-Q-9858A, and MIL-I-45208A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

SIGNED [signature]

DATE 14 FEB 90

RECORD NUMBER: 0005178 NEXT CALIBRATION DUE: 14 AUG 90

SOUTHWEST RESEARCH INSTITUTE

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Division 05 – Instrument Repair and Calibration Laboratory

Calibration Record

ITEM AMPROBE FASTEMP

MODEL T-150 S/N 510111 SWRI NO. 146

PLUG-INS, ETC. PROBE # 146

TOLERANCE WITHIN ± 3° OF STANDARD INDICATION.

STANDARDS

Standard No.	MFGR Model	Description	S/N	Cal. Due	Cal. Rec. No.
	KESSLER 15-0418	THERMOMETER	891-2261	10 FEB 92	04332

ENVIRONMENT: Temperature 76°F Humidity 37%

Location ROOM A11, BLDG 63 SWRI

PROCEDURE

☐ Essentially as outlined in MFGRS Service Manual

☒ SWRI NUCLEAR ~~[illegible]~~ PROJECTS OPERATING PROCEDURE XII-AG-105-2

STANDARD READING	AMPROBE READING	
[illegible]	[illegible]	~~READING AT ROOM TEMP. AFTER 1 HOUR STAB.~~
51.0°F	52°F	READING AT LOW END OF SCALE
98.6°F	95°F	READING AT MID RANGE
129.2°F	130°F	READING AT HIGH END OF RANGE

CONCLUSION LIMITED CALIBRATION (HIGH RANGE ONLY)

☐ Item within tolerance

☐ Item out of tolerance

☐ Item ADJ/repaired to tolerance

☒ ITEM WITHIN LIMITS OF ABOVE PROCEDURE

Calibration was in accord with requirements of MIL-STD-45662A, MIL-Q-9858A, and MIL-I-45208A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

SIGNED Anthony P[illegible]

DATE 2 Jan 90

RECORD NUMBER: 0005097

NEXT CALIBRATION DUE: 2 July 90

SOUTHWEST RESEARCH INSTITUTE

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Division 05 – Instrument Repair and Calibration Laboratory

Calibration Record

ITEM AMPROBE FASTEMP

MODEL T-150 S/N 730012 SWRI NO. 171

PLUG-INS, ETC. PROBE # 171

TOLERANCE ± 3°F OF STANDARD INDICATION.

STANDARDS

Standard No.	MFGR Model	Description	S/N	Cal. Due	Cal. Rec. No.
	15-041B	THERMOMETER	891-2261	10AUG92	04232

ENVIRONMENT: Temperature 72°F Humidity 48%

Location ROOM A11, BLDG 68, SWRI

PROCEDURE

☐ Essentially as outlined in MFGRS Service Manual

☒ SWRI NUCLEAR PROJECTS OPERATING PROCEDURE 12.0-NDES-102:

"STANDARD READING"	"AMPROBE READING"	
44.4°F	44°F	READING AT ROOM TEMP AFTER 1 MIN. ST
93.9°F	94°F	READING AT LOW END OF SCALE
140.0°F	137°F	READING AT MID SCALE
72.5°F	74°F	READING AT HIGH END OF SCALE

CONCLUSION (LIMITED CALIBRATION, HIGH RANGE ONLY)

☐ Item within tolerance

☐ Item out of tolerance

☐ Item ADJ/repaired to tolerance

☒ ITEM WITHIN LIMITS OF ABOVE PROCEDURE.

Calibration was in accord with requirements of MIL-STD-45662A, MIL-Q-9858A, and MIL-I-45208A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

SIGNED [signature]

DATE 14FEB90

RECORD NUMBER: 0005181 NEXT CALIBRATION DUE: 14AUG90

SOUTHWEST RESEARCH INSTITUTE

CERTIFICATION OF CALIBRATION OF
ELECTROMAGNETIC PARTICLE PROBES

THIS IS TO VERIFY THAT THE ELECTROMAGNETIC PARTICLE PROBES LISTED BELOW HAVE BEEN CALIBRATED IN ACCORDANCE WITH SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE 12.0 NDES 119.

MODEL AND SERIAL NUMBER	DATE	CALIBRATED BY
whiteline Yoke WL-1-10	30 Apr 90	[signature]

SWRI FORM PM-24-0

SOUTHWEST RESEARCH INSTITUTE

CERTIFICATION OF CALIBRATION OF

ELECTROMAGNETIC PARTICLE PROBES

THIS IS TO VERIFY THAT THE ELECTROMAGNETIC PARTICLE PROBES LISTED BELOW HAVE BEEN CALIBRATED IN ACCORDANCE WITH SOUTHWEST RESEARCH INSTITUTE NUCLEAR PROJECTS OPERATING PROCEDURE XII-FE-114-0 .

MODEL AND SERIAL NUMBER	DATE	CALIBRATED BY
WHITELINE MAG. PARTICLE YOKE # 4X-115	21 DEC 89	Juan Magallan

SWRI FORM PM-24-0

SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111 • TELEX 76-7357

QUALITY ASSURANCE SYSTEMS
AND ENGINEERING DIVISION

TELEX 767209 NUC ENGR SNT A
TELEX 767579 NUC ENGR SNT
TELECOPIER 684-4822

August 31, 1984

MT WEIGHT CERTIFICATE

This is to verify that the weight stamped on the MT calibration block(s) is the weight of the block before the handle was added. Therfore, the total weight of the block is greater than the weight stamped on it which is greater than ten pounds.

Bruce Mabrito, Manager
Quality Assurance

SAN ANTONIO, TEXAS
WITH OFFICES IN HOUSTON, TEXAS, AND WASHINGTON, D.C.

SOUTHWEST RESEARCH INSTITUTE

INSPECTION AND TEST RESULTS

DRAWING NUMBER:	JOB REQUEST NO.	DATE:	PART NUMBER / PART NAME
B-70198B	12266	3-17-81	SEE ATTACHED LIST

TYPE OF INSPECTION OR TEST PERFORMED:

DIMENSIONAL

INSPECTION / TEST RESULTS: (ATTACH DATA SHEETS AS NECESSARY)

NUMBER OF ARTICLES INSPECTED OR TESTED	NUMBER OF CONFORMING ARTICLES	NUMBER OF ARTICLES REJECTED
16	16	0

NATURE OF DEFECTS OBSERVED:

NONE

BASIC CAUSES FOR ARTICLE REJECTION:

INSPECTION PERFORMED BY: SwRI 8 QA (SIGNATURE) 3-17-81 (DATE)

SWRI FORM PM-19-0

SwRI MAGNETIC PARTICLE WEIGHT CALIBRATION BLOCK
DOCUMENTED CERTIFICATION/WEIGHT VERIFICATION

The following magnetic particle (MP) weight calibration blocks were fabricated by SwRI per drawing B-70198 B. The 1977 Edition of Section V Article 7 Paragraph T-752-3 of the ASME Boiler and Pressure Vessel Code require alternative current electromagnetic yokes demonstrate a minimum lifting power at the maximum pole spacing of 10-pounds (4.5 kg) minimum.

The following weight blocks were fabricated to weigh 1-pound in excess of the Code requirement. This is a verification that the weights were calculated by accurately measuring the blocks (see attached dimensional sheet) and calculating the cubic inches for each block and multiplying by (.28333) weight per cubic inch for steel. This is a verification that the MP weight calibration blocks also meet the intent of the Code requirement by exceeding the 10-pounds minimum weight.

Block ID No.	Calculated Weight	Weight Stamped on Block
B-70198-10	11.325	11.3
B-70198-11	11.326	11.3
B-70198-12	11.322	11.3
B-70198-13	11.317	11.3
B-70198-14	11.326	11.3
B-70198-15	11.318	11.3
B-70198-16	11.315	11.3
B-70198-17	11.322	11.3
B-70198-18	11.318	11.3
B-70198-19	11.312	11.3
B-70198-20	11.323	11.3
B-70198-21	11.322	11.3
B-70198-22	11.327	11.3
B-70198-23	11.322	11.3
B-70198-24	11.329	11.3
B-70198-25	11.327	11.3

Prepared by: [signature] 3/17/81
Robert L. Edwards
Research Engineer

Reviewed by: [signature]
Robert E. Engelhardt 3/17/81
Manager of Quality Assurance

ATTACHMENT

Dimensional Results - Drawing B-70198 B (JR #12266)

ID No.	Thickness	Width	Length
B-70198-10	1.2475	3.9960	8.019
B-70198-11	1.2473	3.9965	8.019
B-70198-12	1.2468	3.9968	8.019
B-70198-13	1.2465	3.9961	8.019
B-70198-14	1.2475	3.9961	8.019
B-70198-15	1.2465	3.9962	8.019
B-70198-16	1.2462	3.9962	8.019
B-70198-17	1.2471	3.9960	8.019
B-70198-18	1.2465	3.9962	8.019
B-70198-19	1.2475	3.9985	8.004
B-70198-20	1.2470	3.9966	8.019
B-70198-21	1.2468	3.9969	8.019
B-70198-22	1.2475	3.9963	8.019
B-70198-23	1.2470	3.9962	8.019
B-70198-24	1.2478	3.9960	8.019
B-70198-25	1.2476	3.9961	8.019

NOTE: Dimensions are in inches

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 01120E

REFERENCE PROCEDURE 12-NDES-107, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 461 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	OK
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: [signature]
(SIGNATURE)

5 Mar 90
(DATE)

SWRI FORM PM-II-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
Sonic MK I	01120E	5 Mar 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45
80 %	40 %	40
70 %	35 %	35
60 %	30 %	30
50 %	25 %	25
40 %	20 %	20
30 %	15 %	15
20 %	10 %	10

6DB & 14DB SWITCH LINEARITY

100 %	− 6DB	49 %
100 %	− 14DB	19 %
40 %	+ 6DB	81 %
10 %	+ 14DB	54 %

CONTROL LINEARITY

80 %	− 6 DB	40 %
80 %	− 12 DB	21 %
40 %	+ 6 DB	82 %
20 %	+ 12 DB	74 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9
8"	8
7"	7
6"	6
5"	5
4"	4
3"	3
2"	2
1"	1

TEST BY: [signature] (SIGNATURE)

SWRI PM-8-1

F-26

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 04325E

REFERENCE PROCEDURE XII-FE-106-0 CH.1, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 431 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) O.K
4. CALIBRATION OF GAIN DB (FINE) O.K.
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	O.K.	REJECT	O.K.
RANGE	O.K.	DELAY POT.	O.K.
FILTER	O.K.	MATL. CAL.	O.K.
REP. RATE	O.K.	DELAY SW.	O.K.
VIDEO SW.	O.K.	THRU TRANS-NORM.	O.K.
DAMPING	O.K.	DEC.	N/A
6 DB SWITCH	O.K.	14 DB SWITCH	O.K.

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10.75 VOLTS) O.K.

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Juan Magallo

(SIGNATURE)

15 DEC 89

(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MK I	04325E	15 DEC 89

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45 %
80 %	40 %	40 %
70 %	35 %	35 %
60 %	30 %	30 %
50 %	25 %	25 %
40 %	20 %	20 %
30 %	15 %	15 %
20 %	10 %	10 %

6DB & 14DB SWITCH LINEARITY

100 %	- 6DB	48 %
100 %	- 14DB	18 %
40 %	+ 6DB	83 %
10 %	+ 14DB	55 %

CONTROL LINEARITY

80 %	- 6 DB	38 %
80 %	- 12 DB	20 %
40 %	+ 6 DB	85 %
20 %	+ 12 DB	80 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: (signature)
(SIGNATURE)

SWRI PM-8-1

F-28

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 04326E

REFERENCE: PROCEDURE XII-FE-106-OCHL, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN ____ 427 MA.
2. AMPLITUDE LINEARITY ____ 1 % FSH
3. CALIBRATION OF GAIN (COARSE) ____ O.K.
4. CALIBRATION OF GAIN DB (FINE) ____ O.K.
5. HORIZONTAL LINEARITY ____ 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	O.K.	REJECT	O.K.
RANGE	O.K.	DELAY POT.	O.K.
FILTER	O.K.	MATL. CAL.	O.K.
REP. RATE	O.K.	DELAY SW.	O.K.
VIDEO SW.	O.K.	THRU TRANS-NORM.	O.K.
DAMPING	O.K.	DEC.	N/A
6 DB SWITCH	O.K.	14 DB SWITCH	O.K.

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10:75 VOLTS) ____ O.K.

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Juan Magallan
(SIGNATURE)

9 JAN 90
(DATE)

SWRI FORM PM-11-2

SRI

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MK I	04326E	9 JAN 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45 %
80 %	40 %	40 %
70 %	35 %	35 %
60 %	30 %	30 %
50 %	25 %	25 %
40 %	20 %	20 %
30 %	15 %	15 %
20 %	10 %	10 %

6DB & 14DB SWITCH LINEARITY

100 %	− 6DB	48 %
100 %	− 14DB	18 %
40 %	+ 6DB	82 %
10 %	+ 14DB	54 %

CONTROL LINEARITY

80 %	− 6 DB	40 %
80 %	− 12 DB	20 %
40 %	+ 6 DB	J.M. ~~2~~ 80 %
20 %	+ 12 DB	80 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: Juan Magallan
(SIGNATURE)

SWRI PM – 8 – 1

F-30

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 0H728E

REFERENCE PROCEDURE XII-FE-106-0-C4; ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 420 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: [signature]
(SIGNATURE)

15 Jun 90
(DATE)

SWRI FORM PM-II-2

F-32

SRI

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
Sonic MK I FTS	OH328E	15 Jan 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45
80 %	40 %	40
70 %	35 %	35
60 %	30 %	30
50 %	25 %	25
40 %	20 %	20
30 %	15 %	15
20 %	10 %	10

CONTROL LINEARITY

80 %	- 6 DB	39 %
80 %	- 12 DB	20 %
40 %	+ 6 DB	84 %
20 %	+ 12 DB	84 %

6DB & 14DB SWITCH LINEARITY

100 %	- 6DB	46 %
100 %	- 14DB	18 %
40 %	+ 6DB	82 %
10 %	+ 14DB	56 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9
8"	8
7"	7
6"	6
5"	5
4"	4
3"	3
2"	2
1"	1

TEST BY: [signature] (SIGNATURE)

SWRI PM-8-1

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 0H329E

REFERENCE PROCEDURE 12.0-NDES-107, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 456 MA.

2. AMPLITUDE LINEARITY 1 % FSH

3. CALIBRATION OF GAIN (COARSE) OK

4. CALIBRATION OF GAIN DB (FINE) OK

5. HORIZONTAL LINEARITY 1 % FSW

6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: [signature]
(SIGNATURE)

13 Feb. 90
(DATE)

SWRI FORM PM-11-2

F-34

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
Sonic Mk I FTS	04329E	13 Feb. 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45
80 %	40 %	40
70 %	35 %	35
60 %	30 %	30
50 %	25 %	25
40 %	20 %	20
30 %	15 %	15
20 %	10 %	10

6DB & 14DB SWITCH LINEARITY

100 %	− 6DB	46 %
100 %	− 14DB	18 %
40 %	+ 6DB	81 %
10 %	+ 14DB	56 %

CONTROL LINEARITY

80 %	− 6 DB	40 %
80 %	− 12 DB	20 %
40 %	+ 6 DB	81 %
20 %	+ 12 DB	81 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9
8"	8
7"	7
6"	6
5"	5
4"	4
3"	3
2"	2
1"	1

TEST BY: [signature]
(SIGNATURE)

SWRI PM-8-1

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. Ø4330E

REFERENCE PROCEDURE XII-FE-106-0 Ch 1, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 435 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:
(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Norman L.J. Roy
(SIGNATURE)

19 JANUARY 1990
(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MARK I	Ø4330E	19 JAN 1990

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45%
80 %	40 %	40%
70 %	35 %	35%
60 %	30 %	30%
50 %	25 %	25%
40 %	20 %	20%
30 %	15 %	15%
20 %	10 %	10%

6DB & 14DB SWITCH LINEARITY

100 %	- 6DB	48 %
100 %	- 14DB	18 %
40 %	+ 6DB	80 %
10 %	+ 14DB	53 %

CONTROL LINEARITY

80 %	- 6 DB	38 %
80 %	- 12 DB	18 %
40 %	+ 6 DB	84 %
20 %	+ 12 DB	80 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: Norman L. J. Roy
(SIGNATURE)

SWRI PM-8-1

F-36

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. Ø6582E

REFERENCE PROCEDURE 12.0-NDES-107, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 445 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Norman L. J. Roy
(SIGNATURE)

2 APRIL 1990
(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
Sonic FTS Mark I	Ø6582E	2 Apr 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45%
80 %	40 %	40%
70 %	35 %	35%
60 %	30 %	30%
50 %	25 %	25%
40 %	20 %	20%
30 %	15 %	15%
20 %	10 %	10%

6DB & 14DB SWITCH LINEARITY

100 %	– 6DB	50 %
100 %	– 14DB	20 %
40 %	+ 6DB	75 %
10 %	+ 14DB	57 %

CONTROL LINEARITY

80 %	– 6 DB	38 %
80 %	– 12 DB	18 %
40 %	+ 6 DB	84 %
20 %	+ 12 DB	84 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: [signature]
((SIGNATURE) (

SWRI PM-8-1

F-38

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. Ø69Ø7E

REFERENCE PROCEDURE XII-FE-106-OCh1, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 405 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT :

(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION :

ALIGNMENT PERFORMED BY : Norman L. J. Roy

(SIGNATURE)

9 JAN 90

(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

SRI

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MARK I	Ø69Ø7E	9 JAN 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45%
80 %	40 %	40%
70 %	35 %	35%
60 %	30 %	30%
50 %	25 %	25%
40 %	20 %	20%
30 %	15 %	15%
20 %	10 %	10%

6DB & 14DB SWITCH LINEARITY

100 %	− 6DB	48 %
100 %	− 14DB	18 %
40 %	+ 6DB	80 %
10 %	+ 14DB	52 %

CONTROL LINEARITY

80 %	− 6 DB	40 %
80 %	− 12 DB	20 %
40 %	+ 6 DB	82 %
20 %	+ 12 DB	84 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: Norman L. J. Roy
(SIGNATURE)

SWRI ... PM-8-1

SRI

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 774101

REFERENCE PROCEDURE XII-FE-106-0-, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 421 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10.75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: [signature]
(SIGNATURE)

17 Jan 90
(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
Sonic MK I FTS	774101	17Jun90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45
80 %	40 %	40
70 %	35 %	35
60 %	30 %	30
50 %	25 %	25
40 %	20 %	20
30 %	15 %	15
20 %	10 %	10

6DB & 14DB SWITCH LINEARITY

100 %	– 6DB	48 %
100 %	– 14DB	18 %
40 %	+ 6DB	84 %
10 %	+ 14DB	56 %

CONTROL LINEARITY

80 %	– 6 DB	38 %
80 %	– 12 DB	19 %
40 %	+ 6 DB	85 %
20 %	+ 12 DB	82 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9
8"	8
7"	7
6"	6
5"	5
4"	4
3"	3
2"	2
1"	1

TEST BY: David E. [signature]
(SIGNATURE)

SWRI PM-8-1

F-42

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 774210

REFERENCE PROCEDURE XII-FE-106-0 Ch 1, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 440 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) OK
4. CALIBRATION OF GAIN DB (FINE) OK
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:
(JUST ON AT 10:75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Norman L. J. Roy
(SIGNATURE)

20 DEC 1989
(DATE)

SWRI FORM PM-11-2

SRI

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MARK I	774210	20 DEC 1989

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45%
80 %	40 %	40%
70 %	35 %	35%
60 %	30 %	30%
50 %	25 %	25%
40 %	20 %	20%
30 %	15 %	15%
20 %	10 %	10%

6DB & 14DB SWITCH LINEARITY

100 %	- 6DB	50 %
100 %	-14DB	18 %
40 %	+ 6DB	78 %
10 %	+ 14DB	50 %

CONTROL LINEARITY

80 %	- 6 DB	38 %
80 %	-12 DB	20 %
40 %	+ 6 DB	82 %
20 %	+ 12 DB	83 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: Norman L. J. Roy
(SIGNATURE)

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 774224

REFERENCE PROCEDURE XII-FE-106-0 CH1, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 467 MA.
2. AMPLITUDE LINEARITY 1 % FSH
3. CALIBRATION OF GAIN (COARSE) O.K.
4. CALIBRATION OF GAIN DB (FINE) O.K.
5. HORIZONTAL LINEARITY 1 % FSW
6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	O.K.	REJECT	O.K.
RANGE	O.K.	DELAY POT.	O.K.
FILTER	O.K.	MATL. CAL.	O.K.
REP. RATE	O.K.	DELAY SW.	O.K.
VIDEO SW.	O.K.	THRU TRANS-NORM.	O.K.
DAMPING	O.K.	DEC.	N/A
6 DB SWITCH	O.K.	14 DB SWITCH	O.K

7. LOW BATTERY LIGHT ADJUSTMENT:

(JUST ON AT 10:75 VOLTS) O.K.

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Juan Mogallan

(SIGNATURE)

10 JAN 90

(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MK I	774224	10 JAN 90

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45 %
80 %	40 %	40 %
70 %	35 %	35 %
60 %	30 %	30 %
50 %	25 %	25 %
40 %	20 %	20 %
30 %	15 %	15 %
20 %	10 %	10 %

6DB & 14DB SWITCH LINEARITY

100 %	− 6DB	48 %
100 %	− 14DB	17 %
40 %	+ 6DB	82 %
10 %	+ 14DB	56 %

CONTROL LINEARITY

80 %	− 6 DB	40 %
80 %	− 12 DB	20 %
40 %	+ 6 DB	80 %
20 %	+ 12 DB	80 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY : Juan Magallan
(SIGNATURE)

SWRI PM-8-1

F-46

SONIC FTS MARK I FLAW DETECTOR CALIBRATION

I OPERATIONAL CHECKLIST FOR SONIC FTS MK I No. 774226

REFERENCE PROCEDURE XII-FE-106-0Ch1, ALIGNMENT OF SONIC FTS MARK I FLAW DETECTOR

1. CURRENT DRAIN 460 MA.

2. AMPLITUDE LINEARITY 1 % FSH

3. CALIBRATION OF GAIN (COARSE) OK

4. CALIBRATION OF GAIN DB (FINE) OK

5. HORIZONTAL LINEARITY 1 % FSW

6. CHECKS OF POTS AND SWITCHES:

FREQUENCY MHZ	OK	REJECT	OK
RANGE	OK	DELAY POT.	OK
FILTER	OK	MATL. CAL.	OK
REP. RATE	OK	DELAY SW.	OK
VIDEO SW.	OK	THRU TRANS-NORM.	OK
DAMPING	OK	DEC.	N/A
6 DB SWITCH	OK	14 DB SWITCH	OK

7. LOW BATTERY LIGHT ADJUSTMENT:
(JUST ON AT 10:75 VOLTS) OK

II CERTIFICATION:

ALIGNMENT PERFORMED BY: Norman 2. J. Roy
(SIGNATURE)

6 DECEMBER 1989
(DATE)

SWRI FORM PM-11-2

INSTRUMENT VERIFICATION RECORD

INSTRUMENT	SERIAL NO.	DATE
SONIC FTS MARK I	774226	6 DEC 1989

AMPLITUDE LINEARITY

LARGER ECHO	SMALLER ECHO NOMINAL	ACTUAL
100 %	50 %	50 % FSH
90 %	45 %	45%
80 %	40 %	40%
70 %	35 %	35%
60 %	30 %	30%
50 %	25 %	25%
40 %	20 %	20%
30 %	15 %	15%
20 %	10 %	10%

6DB & 14DB SWITCH LINEARITY

100 %	− 6DB	50 %
100 %	− 14DB	18 %
40 %	+ 6DB	79 %
10 %	+ 14DB	53 %

CONTROL LINEARITY

80 %	− 6 DB	38 %
80 %	− 12 DB	20 %
40 %	+ 6 DB	82 %
20 %	+ 12 DB	82 %

DISTANCE LINEARITY

ACTUAL THICKNESS	ULTRASONIC MEASURED
10"	10"
9"	9"
8"	8"
7"	7"
6"	6"
5"	5"
4"	4"
3"	3"
2"	2"
1"	1"

TEST BY: Norman L.J. Cory
(SIGNATURE)

SWI PM-8-1

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 10, 1990
NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH
CASE STYLE: RECT.
CRYSTAL SIZE: .50 X 1.0

SERIAL NO: 013724
TEST ANGLE = : 0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :19 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.34 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

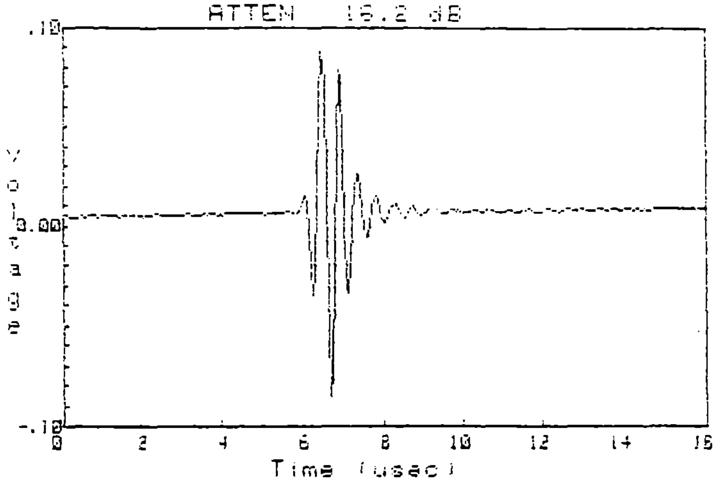
10 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

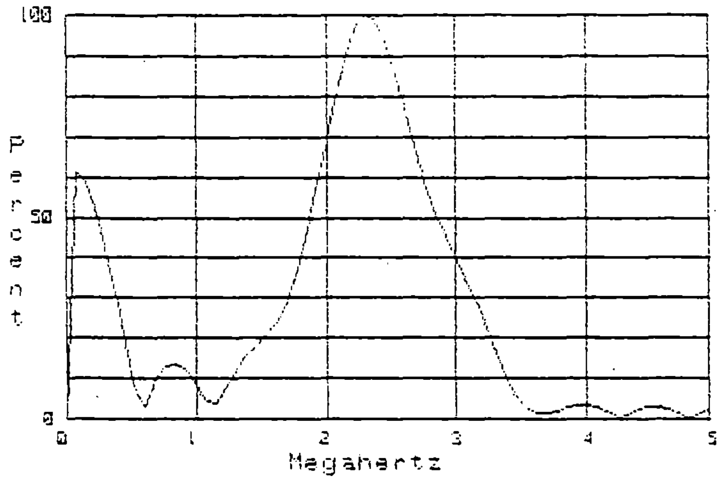
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

MANUFACTURE: AEROTECH SERIAL No: 013724
CERTIFICATION DATE: JAN 10, 1990

ANALOG SCAN
ATTEN 16.2 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 10, 1990

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH
CASE STYLE: RECT.
CRYSTAL SIZE: .50 X 1.0

SERIAL NO: 015840
TEST ANGLE = : 0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE	MODEL	SERIAL #
TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :19 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. O. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz
MEASURED FREQUENCY = : 2.27 Mhz
ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC
MODEL :MARK I
SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

10 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

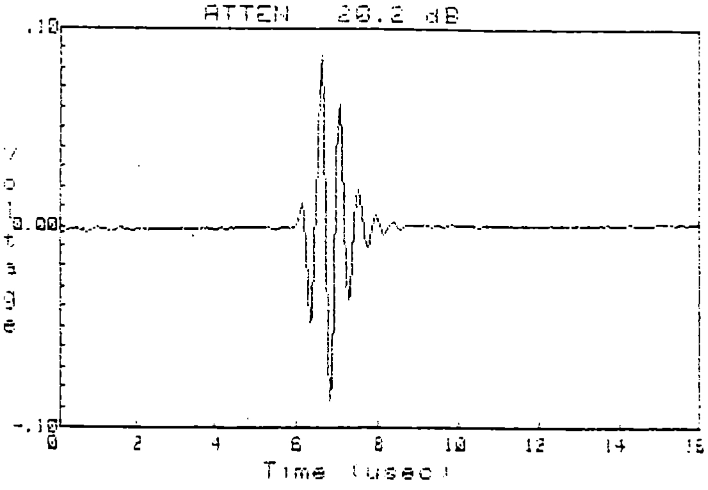
MANUFACTURE: AEROTECH SERIAL No: 015840

PAGE 2 of 2

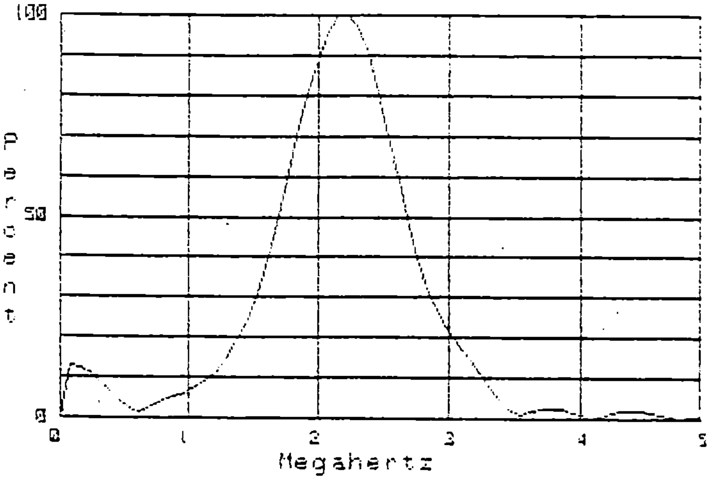
CERTIFICATION DATE: JAN 10, 1990

ANALOG SCAN

ATTEN 20.2 dB



POWER SPECTRUM



------- S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT ---------

CERT DATE: FEB 1, 1990 Page 1 of 2

NAME OF OPERATOR : B. HUFFMAN

----- TRANSDUCER INFORMATION -----

MANUFACTURE: AEROTECH
CASE STYLE: ROUND
CRYSTAL SIZE: .250 DUAL

SERIAL NO: A10067
TEST ANGLE = : 0
FREQUENCY = : 2.25

------- WAVEFORM AND POWER SPECTRUM INST. -------

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

------- UTA SETTING -------

ATTENUATION = :16 MODE = :THRU REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

------- TARGET REFLECTOR INFORMATION ---------

OTHER = :1 INCH SECTION ON PT 300 BLOCK.

------- FREQUENCY AND SPECTRUM ANALYSIS ---------

ACCEPTABLE MINIMUM = : 1.8 Mhz

MEASURED FREQUENCY = : 2.66 Mhz

ACCEPTABLE MAXIMUM = : 2.7 Mhz

------- ULTRASONIC INST. -- DAC CURVE -------

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

2/1/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XI-FE-125

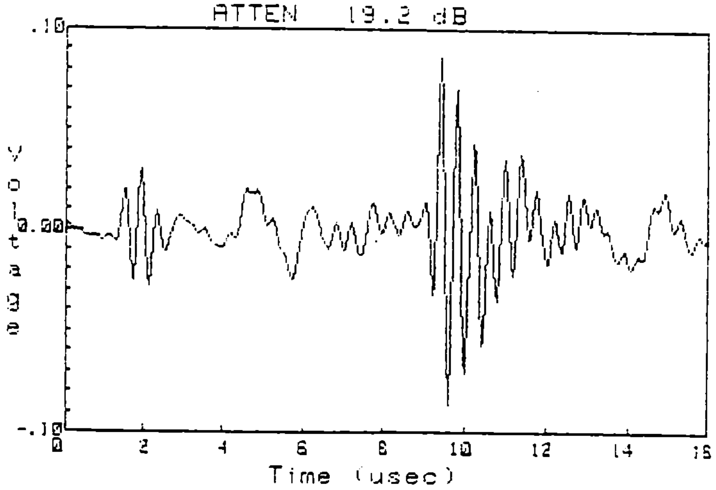
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: A10067

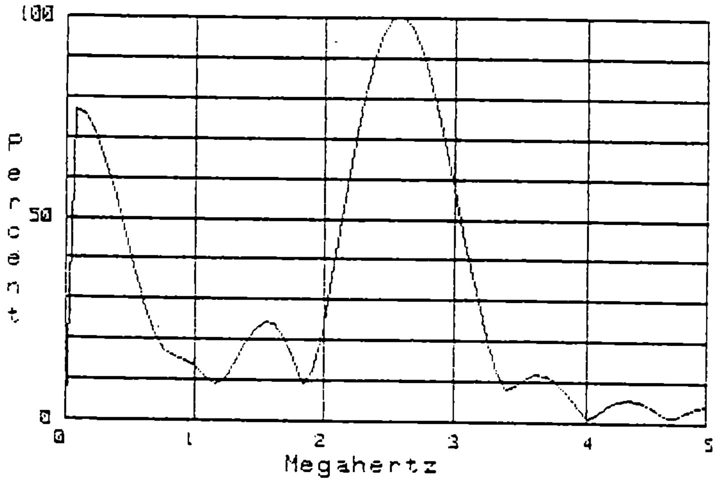
CERTIFICATION DATE: FEB 1, 1990

ANALOG SCAN

ATTEN 19.2 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: SEPT 27, 1989

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH SERIAL NO: 814232
CASE STYLE: DIAMOND TEST ANGLE = : 0
CRYSTAL SIZE: .250 FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :17 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz MEASURED FREQUENCY = : 2.27 Mhz ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BJH

Billy J. Huffman
SIGNATURE

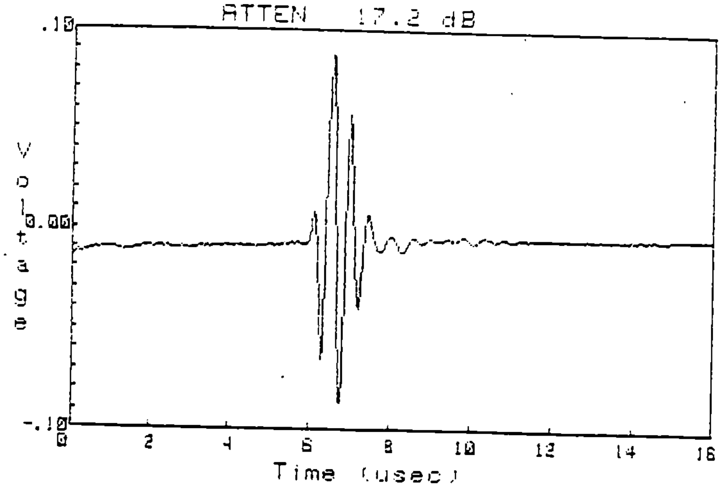
9/27/89
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

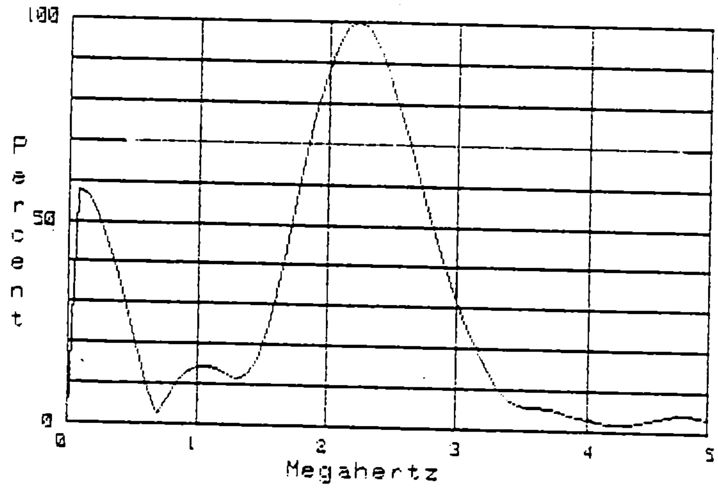
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: AEROTECH SERIAL No: B14232
CERTIFICATION DATE: SEPT 27, 1989

ANALOG SCAN
ATTEN 17.2 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 9, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH	SERIAL NO: 815962
CASE STYLE: ROUND	TEST ANGLE = : 0
CRYSTAL SIZE: .250	FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :15 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.11 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC

MODEL :MARK I

SERIAL No. :01109E

Db SETTING :39

Billy G. Huffman

SIGNATURE

2/9/90

DATE

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

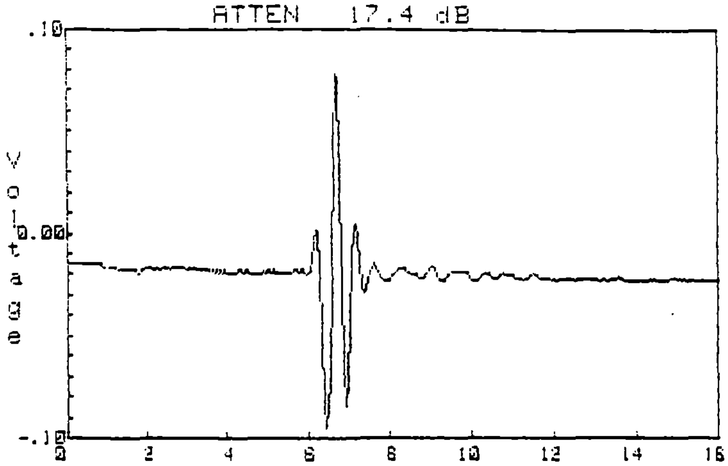
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: B15962

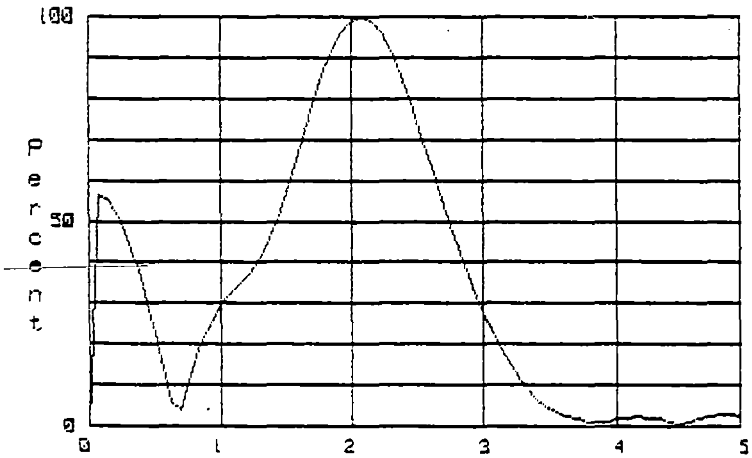
CERTIFICATION DATE: FEB 9, 1990

ANALOG SCAN

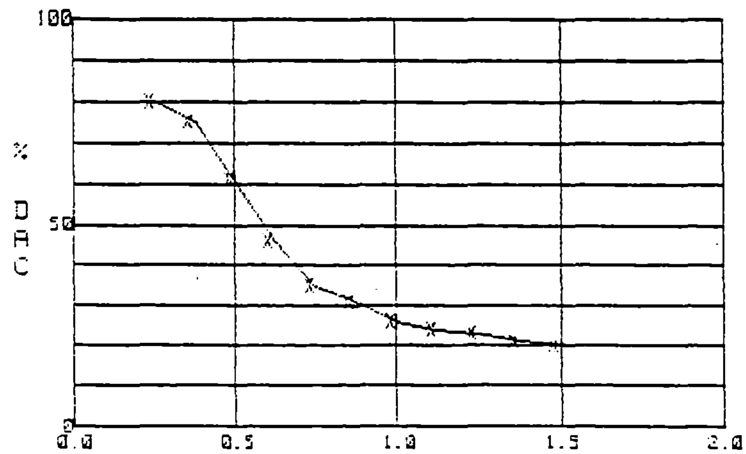
ATTEN 17.4 dB



POWER SPECTRUM



DAC CURVE



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: NOV 7, 1989

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH SERIAL NO: D13514
CASE STYLE: ROUND TEST ANGLE = : 0
CRYSTAL SIZE: .250 FREQUENCY = : 5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :15 MODE = :THRU REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

OTHER = :1 INCH SECTION ON PT 300 BLOCK.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 4 Mhz
MEASURED FREQUENCY = : 4.53 Mhz
ACCEPTABLE MAXIMUM = : 6 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :
NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

7 Nov 1989
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-125

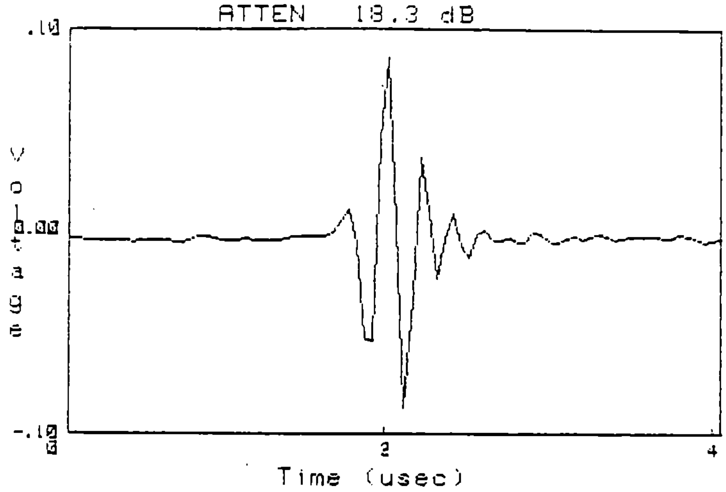
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: 013514

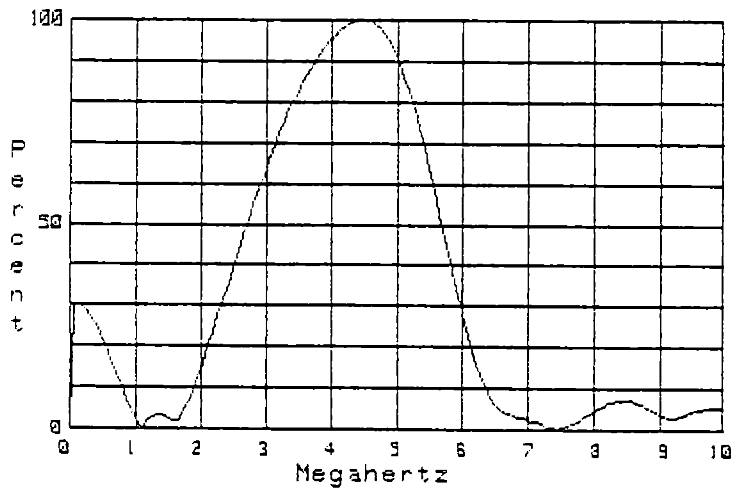
CERTIFICATION DATE: NOV 7, 1989

ANALOG SCAN

ATTEN 18.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: NOV 7, 1989

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE:	AEROTECH	SERIAL NO:	E09485
CASE STYLE:	ROUND	TEST ANGLE = :	0
CRYSTAL SIZE:	.250	FREQUENCY = :	5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :2 MODE = :THRU REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

OTHER = :1 INCH SECTION ON PT 300 BLOCK.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 4 Mhz	FREQUENCY = : 4.69 Mhz	MAXIMUM = : 6 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E

Db SETTING : NOT APPLICABLE BH

Billy G. Huffman 7 Nov 1989

SIGNATURE DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-125

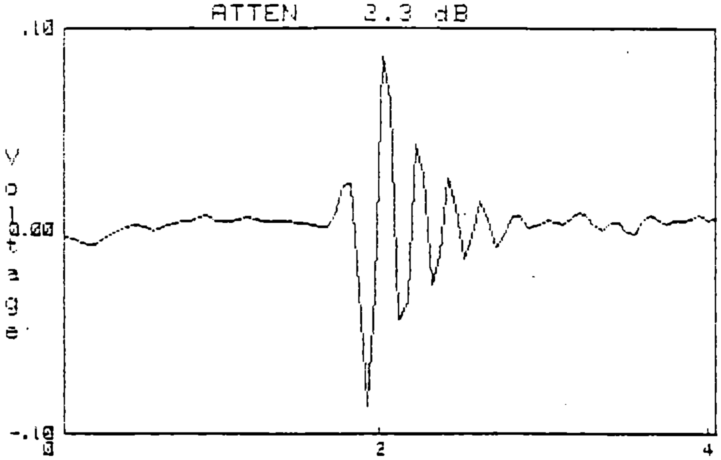
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: E09485

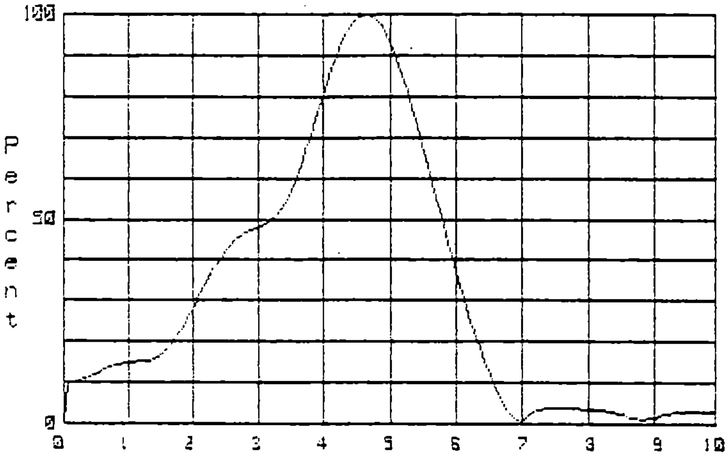
CERTIFICATION DATE: NOV 7, 1989

ANALOG SCAN

ATTEN 2.3 dB



POWER SPECTRUM



------- S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT ---------

CERT DATE: OCT 11, 1989 Page 1 of 2
NAME OF OPERATOR : B.HUFFMAN

----- TRANSDUCER INFORMATION -----

MANUFACTURE:	AEROTECH	SERIAL NO:	E14227
CASE STYLE:	DIAMOND	TEST ANGLE = :	0
CRYSTAL SIZE:	.250	FREQUENCY = :	2.25

------- WAVEFORM AND POWER SPECTRUM INST. -------

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

------- UTA SETTING -------

ATTENUATION = :20 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

------- TARGET REFLECTOR INFORMATION ---------

PLASTIC BALL BLOCK S. D. H.

------- FREQUENCY AND SPECTRUM ANALYSIS ---------

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.27 Mhz	MAXIMUM = : 2.7 Mhz

------- ULTRASONIC INST. -- DAC CURVE -------

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

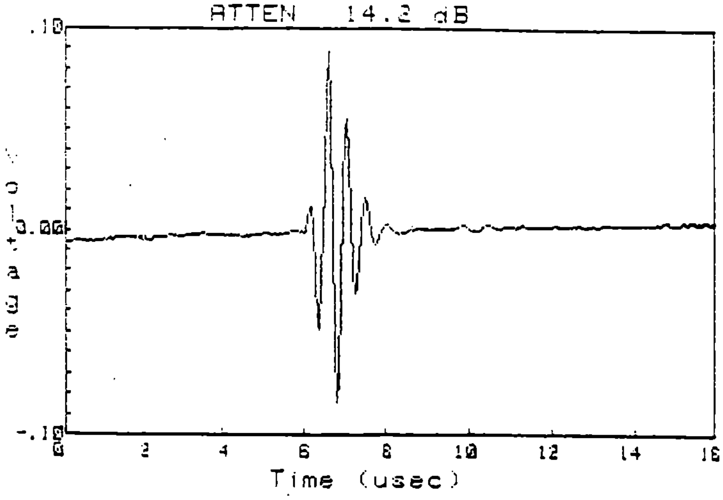
10/11/89
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

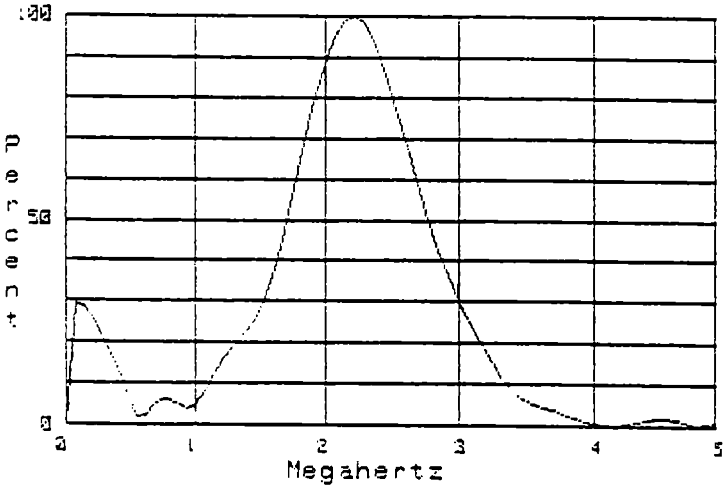
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-125

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: AEROTECH SERIAL No: E14227
CERTIFICATION DATE: OCT 11, 1989

ANALOG SCAN
ATTEN 14.2 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: NOV 7, 1989

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH	SERIAL NO: G21649
CASE STYLE: ROUND	TEST ANGLE = : 0
CRYSTAL SIZE: .250 DUAL	FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :3 MODE = :THRU REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

OTHER = :1 INCH SECTION ON PT 300 BLOCK.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.42 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE BH

Billy G. Huffman

SIGNATURE

7 Nov 1989

DATE

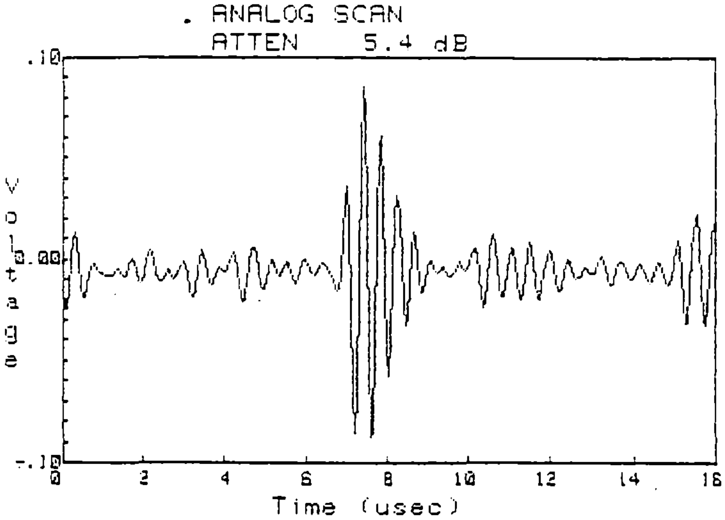
NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

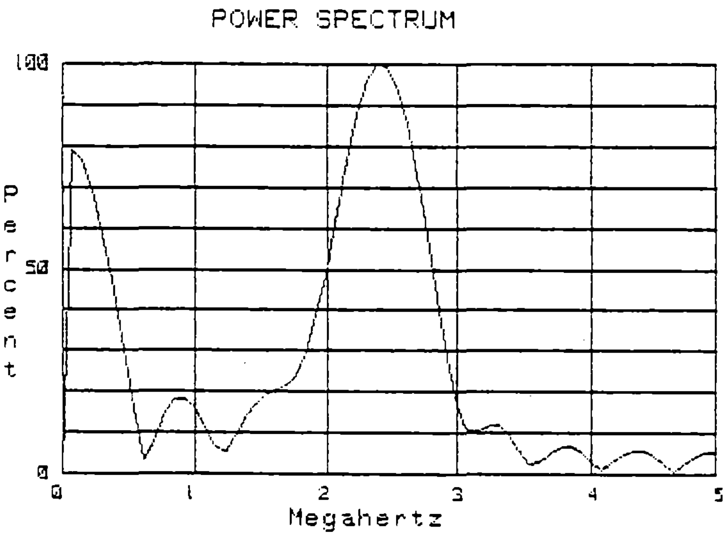
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: G21649

CERTIFICATION DATE: NOV 7, 1989





S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 8, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH
CASE STYLE: DIAMOND
CRYSTAL SIZE: .250

SERIAL NO: H24817
TEST ANGLE = : 0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :19 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz
MEASURED FREQUENCY = : 2.34 Mhz
ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BJH

Billy G. Huffman
SIGNATURE

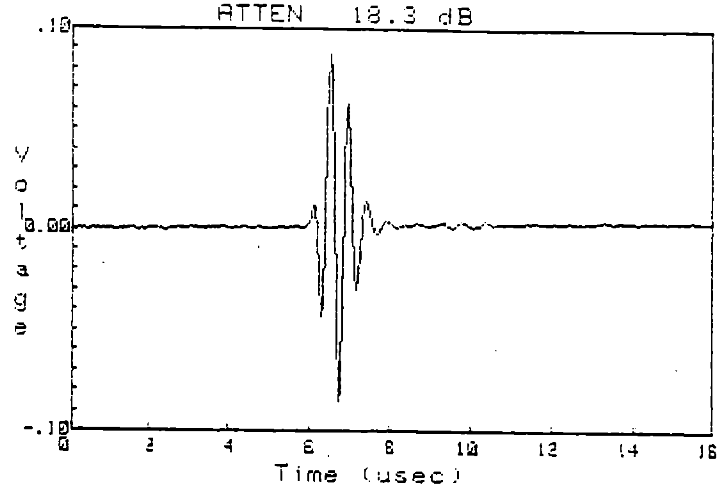
2/8/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

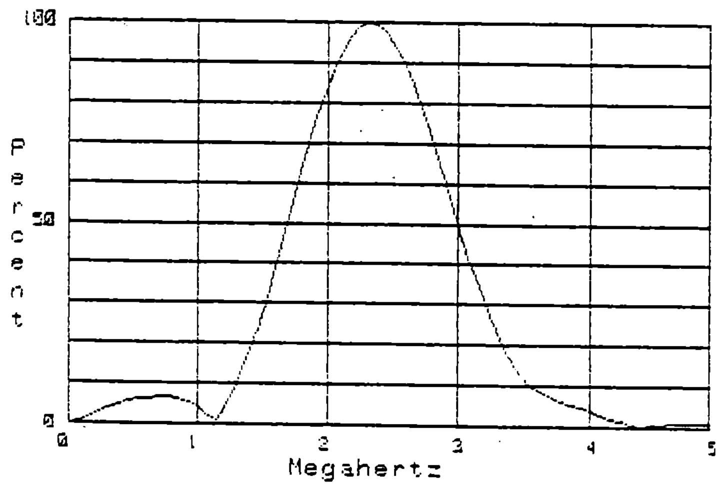
CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XI-II-115~~ 1.2-C-NDES-116-0

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: AEROTECH SERIAL No: H24817
CERTIFICATION DATE: FEB 8, 1990

ANALOG SCAN
ATTEN 18.3 dB



POWER SPECTRUM



S.W.P.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 5, 1990 — Page 1 of 2

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH — SERIAL NO: H28912

CASE STYLE: ROUND — TEST ANGLE = : 0

CRYSTAL SIZE: .250 DUAL — FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH — MODEL: UTA-2 — SERIAL #:1214

TYPE: HP WAVEFORM RECORDER — MODEL: 5180A — SERIAL #:2313A00667

UTA SETTING

ATTENUATION = :14 — MODE = :THRU — REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

OTHER = :1 INCH SECTION ON PT 300 BLOCK.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz

MEASURED FREQUENCY = : 2.58 Mhz

ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC — MODEL :MARK I — SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE BJH

Billy J. Huffman
SIGNATURE

1/5/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-125

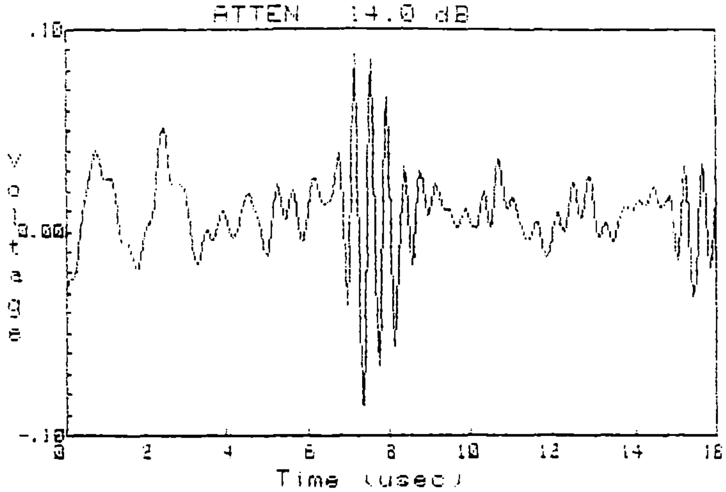
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: H28912

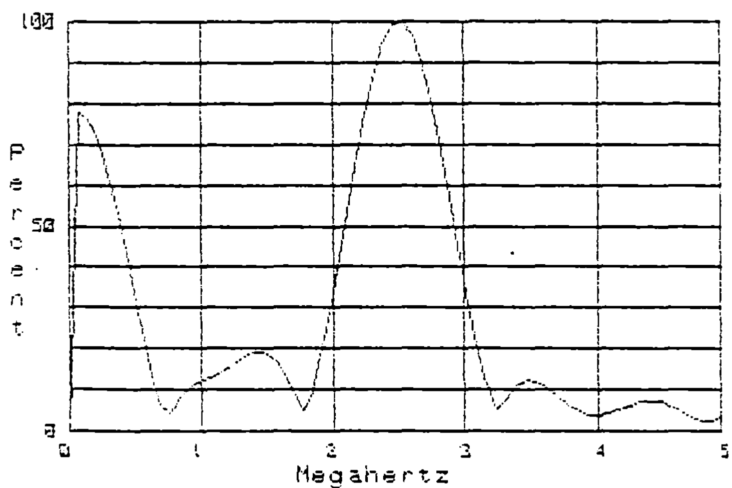
CERTIFICATION DATE: JAN 5, 1990

ANALOG SCAN

ATTEN 14.0 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: SEPT 15, 1989 — Page 1 of 2
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH	SERIAL NO: H31981
CASE STYLE: DIAMOND	TEST ANGLE = : 0
CRYSTAL SIZE: .250	FREQUENCY = : 5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :17 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER .

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 4 Mhz	FREQUENCY = : 4.69 Mhz	MAXIMUM = : 8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :
NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

9/15/89
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH [illegible]

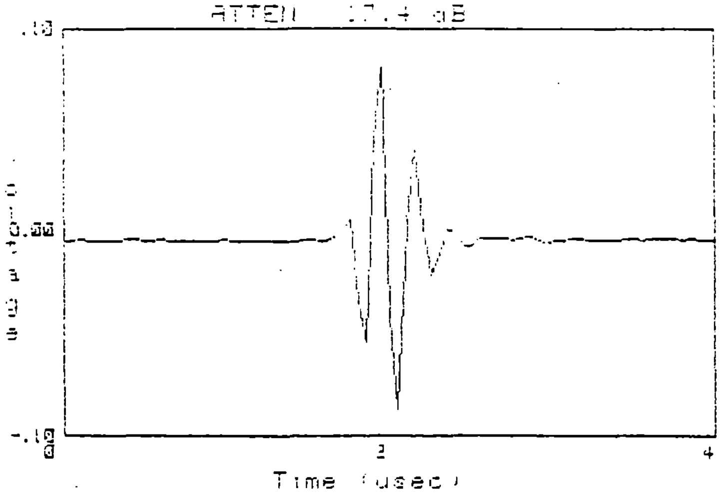
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: [illegible]

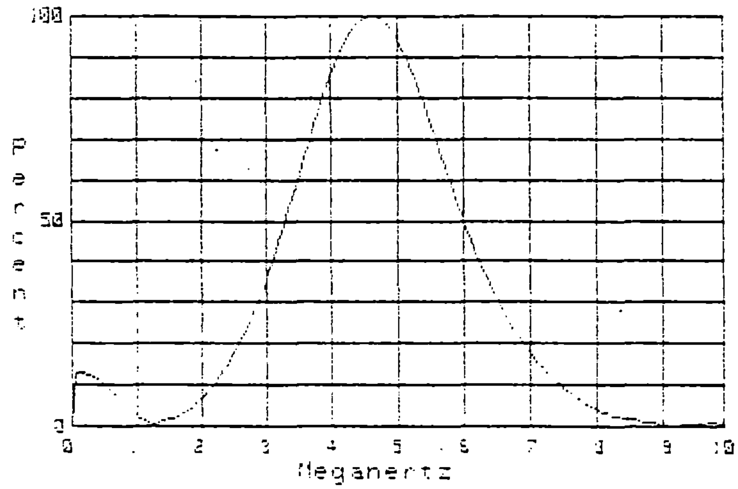
CERTIFICATION DATE: SEPT 15, 1989

ANALOG SCAN

ATTEN 17.4 dB



POWER SPECTRUM



------- S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT ---------

CERT DATE: FEB 8, 1990

NAME OF OPERATOR : B. HUFFMAN

----- TRANSDUCER INFORMATION -----

MANUFACTURE: AEROTECH	SERIAL NO: J16834
CASE STYLE: DIAMOND	TEST ANGLE = : 0
CRYSTAL SIZE: .250	FREQUENCY = : 2.25

------- WAVEFORM AND POWER SPECTRUM INST. -------

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

------- UTA SETTING -------

ATTENUATION = :19 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

------- TARGET REFLECTOR INFORMATION ---------

PLASTIC BALL BLOCK S. D. H.

------- FREQUENCY AND SPECTRUM ANALYSIS ---------

ACCEPTABLE MINIMUM = : 1.8 Mhz	MEASURED FREQUENCY = : 2.27 Mhz	ACCEPTABLE MAXIMUM = : 2.7 Mhz

------- ULTRASONIC INST. -- DAC CURVE -------

TYPE :SONIC	MODEL :MARK I	SERIAL No. :01109E
	Db SETTING :	

NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

3/7/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~X-TE-125~~ 12-C-NDES-116-C

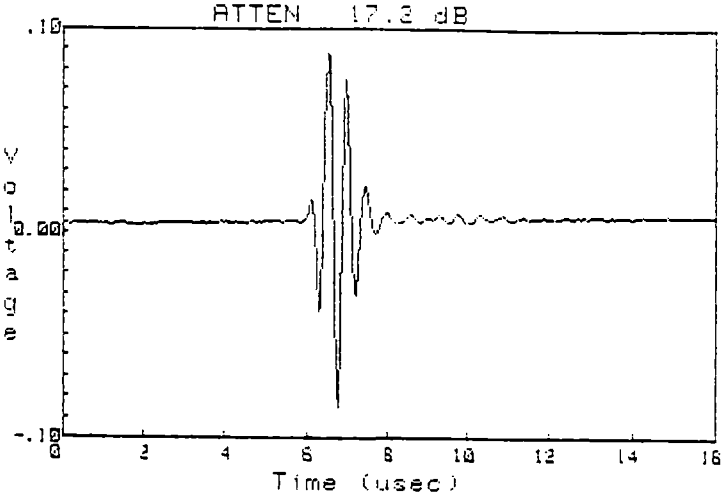
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: J16834

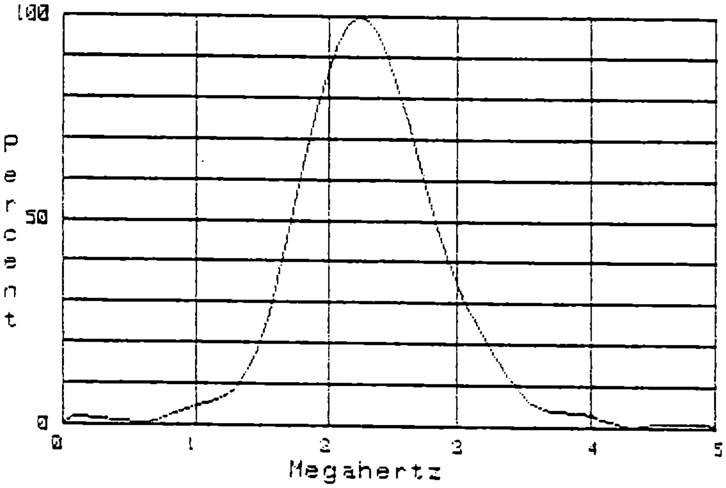
CERTIFICATION DATE: FEB 9, 1990

ANALOG SCAN

ATTEN 17.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 8, 1990
NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH
CASE STYLE: DIAMOND
CRYSTAL SIZE: .250

SERIAL NO: K20205
TEST ANGLE = : 0
FREQUENCY = : 5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :21 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. O. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 4 Mhz
MEASURED FREQUENCY = : 4.30 Mhz
ACCEPTABLE MAXIMUM = : 6 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Billy B. Huffman
SIGNATURE

2/7/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XII-FE-125~~ W.O. NOES-116-0

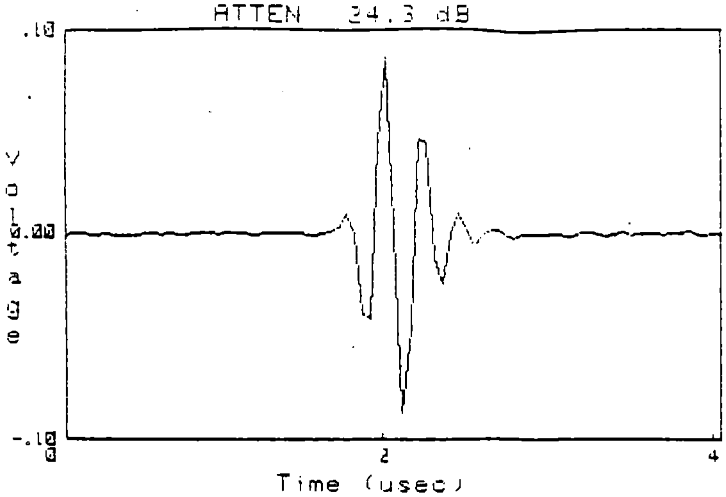
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL NO: K20205 PAGE 2 of 2

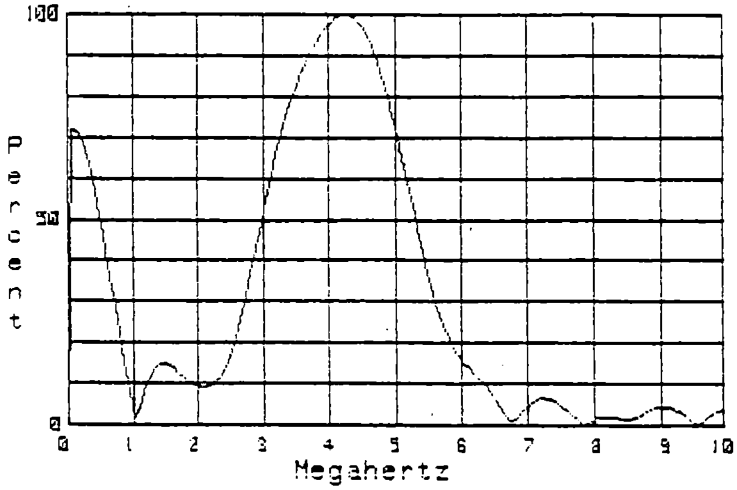
CERTIFICATION DATE: FEB 8, 1990

ANALOG SCAN

ATTEN 24.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 8, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH — SERIAL NO: K30084
CASE STYLE: DIAMOND — TEST ANGLE = : 0
CRYSTAL SIZE: .250 — FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH — MODEL: UTA-2 — SERIAL #:1214
TYPE: HP WAVEFORM RECORDER — MODEL: 5180A — SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :19 — MODE = :NORM — REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz — MEASURED FREQUENCY = : 2.42 Mhz — ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC — MODEL :MARK I — SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE 7-8 BH

Billy G. Huffman
SIGNATURE

2/7/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~[illegible]~~ 1210-NDES 116-C

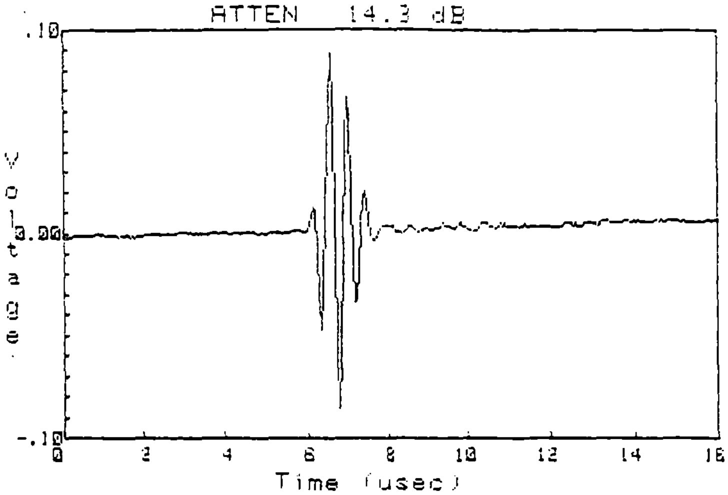
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: K30084

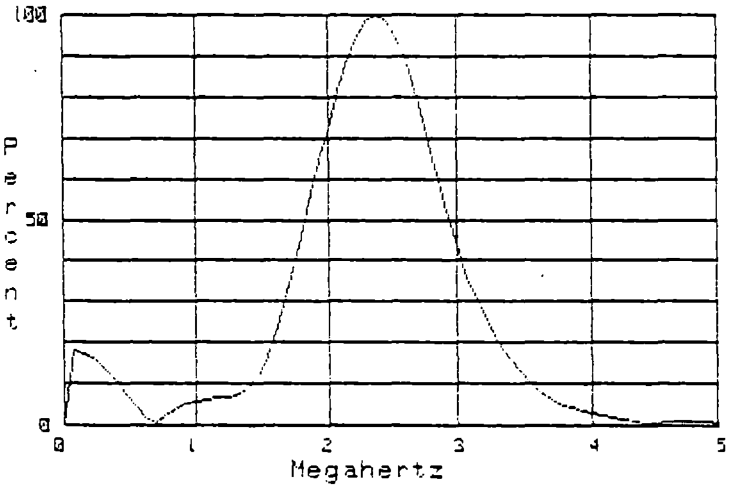
CERTIFICATION DATE: FEB 8, 1990

ANALOG SCAN

ATTEN 14.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 9, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: AEROTECH
CASE STYLE: DIAMOND
CRYSTAL SIZE: .250

SERIAL NO: M16258
TEST ANGLE = : 0
FREQUENCY = : 5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :19 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 4 Mhz
MEASURED FREQUENCY = : 4.06 Mhz
ACCEPTABLE MAXIMUM = : 6 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE ØA

SIGNATURE

2/9/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XII-PE-135~~ 12-C-NDES-116-C

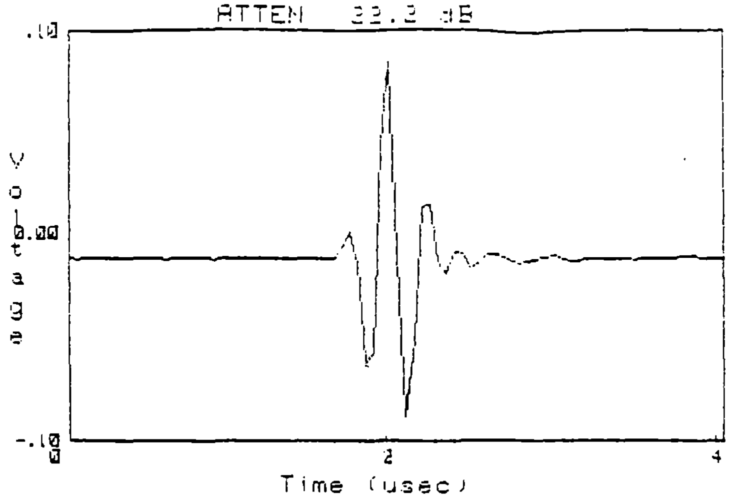
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: AEROTECH SERIAL No: M15258

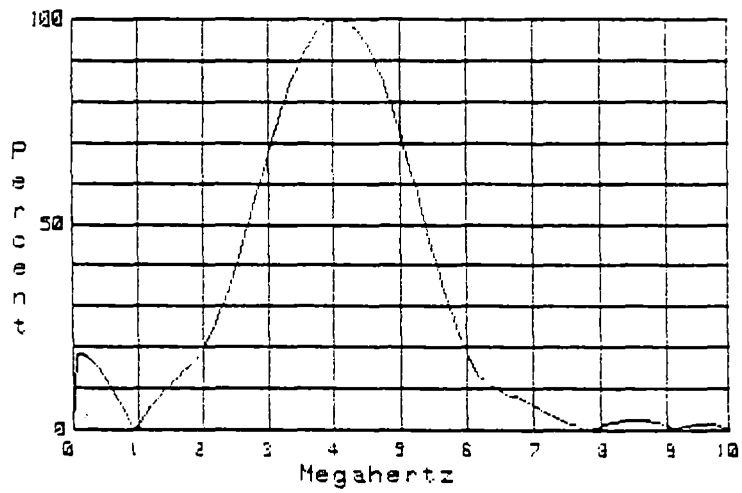
CERTIFICATION DATE: FEB 5, 1990

ANALOG SCAN

ATTEN 22.2 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 8, 1990 Page 1 of 2
NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE:	AEROTECH	SERIAL NO:	M16260
CASE STYLE:	DIAMOND	TEST ANGLE = :	0
CRYSTAL SIZE:	.250	FREQUENCY = :	5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :18 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 4 Mhz	MEASURED FREQUENCY = : 4.14 Mhz	ACCEPTABLE MAXIMUM = : 6 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

2/8/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

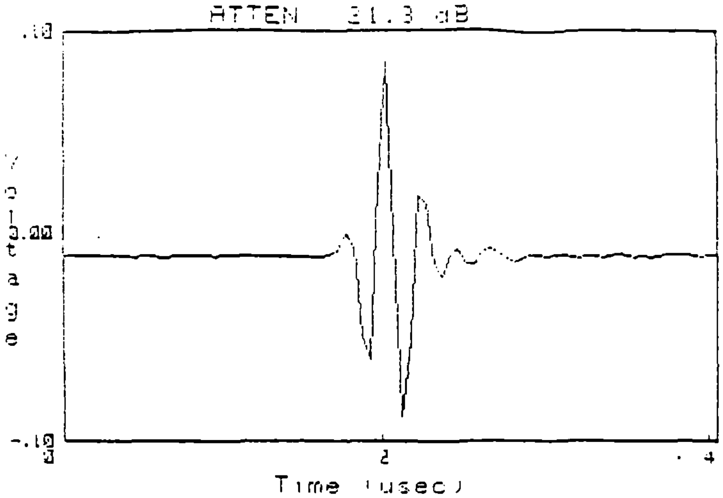
CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XII-FE-126~~ 12-C-NDES-116-C

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

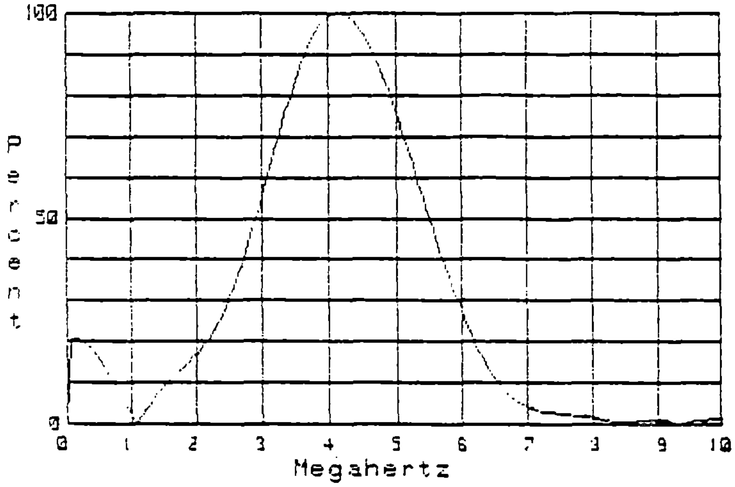
MANUFACTURE: AEROTECH SERIAL No: 416250

CERTIFICATION DATE: FEB 8, 1990

ANALOG SCAN
ATTEN 31.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 10, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .50 X 1.0

SERIAL NO: 750
TEST ANGLE = : 0
FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :19   MODE = :NORM   REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.2 Mhz	FREQUENCY = : 1.56 Mhz	MAXIMUM = : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC   MODEL :MARK I   SERIAL No. :01109E

Db SETTING : **NOT APPLICABLE** BH

Billy G. Huffman
SIGNATURE

10 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

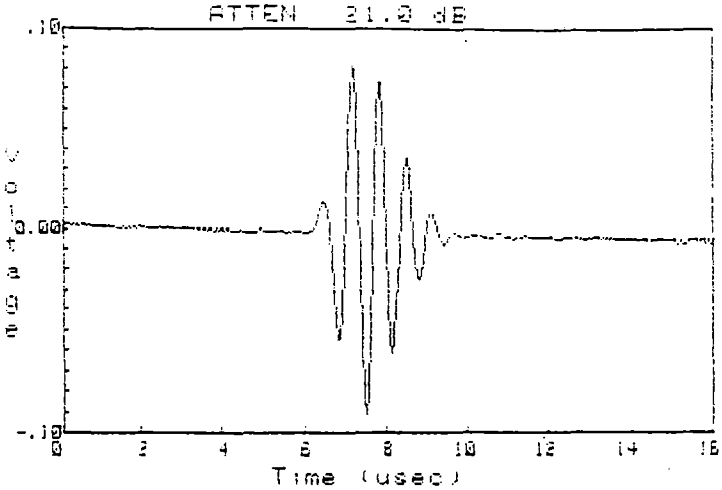
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 750

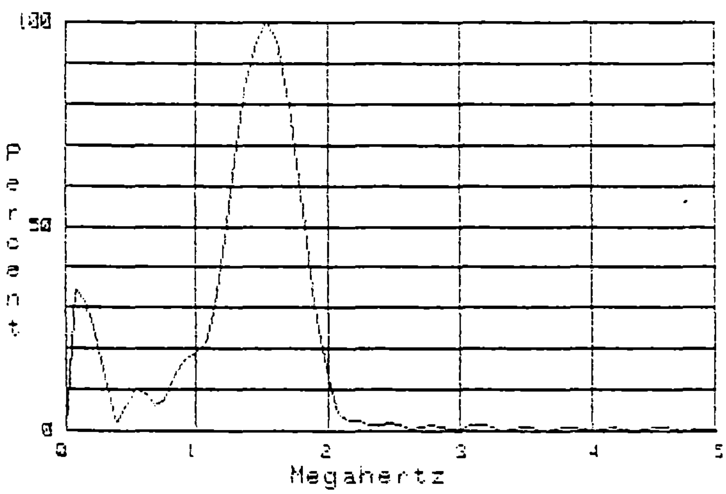
CERTIFICATION DATE: JAN 10, 1990

ANALOG SCAN

ATTEN 21.0 dB



POWER SPECTRUM



------- S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT ---------

CERT DATE: SEPT 21, 1989
NAME OF OPERATOR : B.HUFFMAN

----- TRANSDUCER INFORMATION -----

MANUFACTURE: SWRI	SERIAL NO: 785
CASE STYLE: ROUND	TEST ANGLE = : 0
CRYSTAL SIZE: .50	FREQUENCY = : 2.25

------- WAVEFORM AND POWER SPECTRUM INST. -------

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

------- UTA SETTING -------

ATTENUATION = :19 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

------- TARGET REFLECTOR INFORMATION ---------

3/16 IN. 3/4 T HOLE IN E.E.I. BLOCK

------- FREQUENCY AND SPECTRUM ANALYSIS ---------

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.66 Mhz	MAXIMUM = : 2.7 Mhz

------- ULTRASONIC INST. -- DAC CURVE -------

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :37

Bill G. Heckman
SIGNATURE

9/21/89
DATE

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

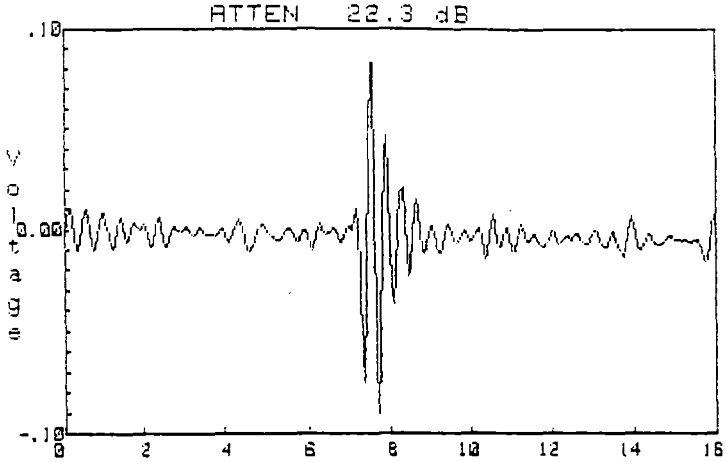
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 785

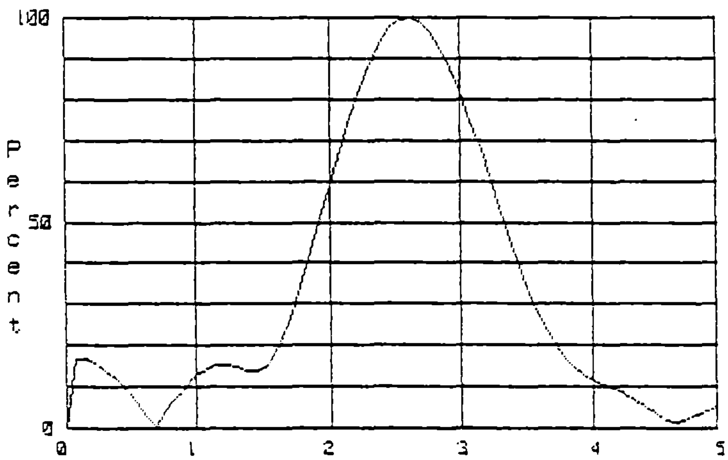
CERTIFICATION DATE: SEPT 21, 1989

ANALOG SCAN

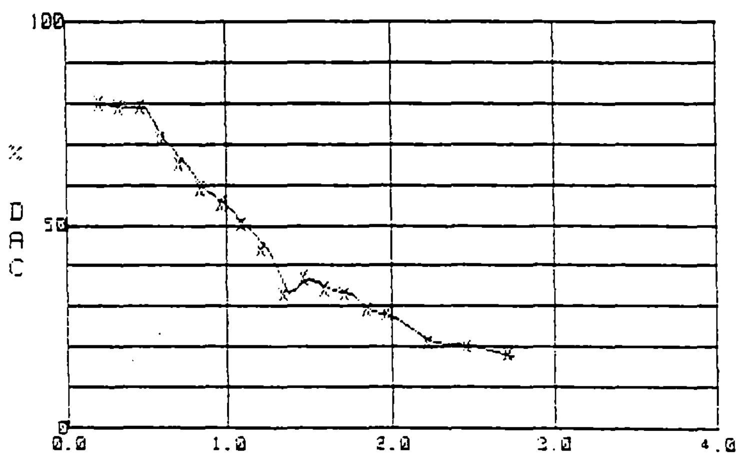
ATTEN 22.3 dB



POWER SPECTRUM



DAC CURVE



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 9, 1990
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI SERIAL NO: 809
CASE STYLE: RECT. TEST ANGLE = : 0
CRYSTAL SIZE: .375 FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :16 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz
MEASURED FREQUENCY = : 2.27 Mhz
ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Bill G. Huffman
SIGNATURE

9 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

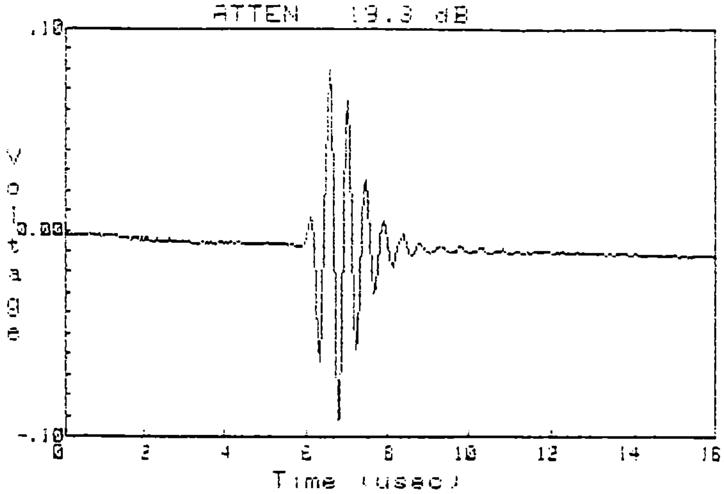
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 309

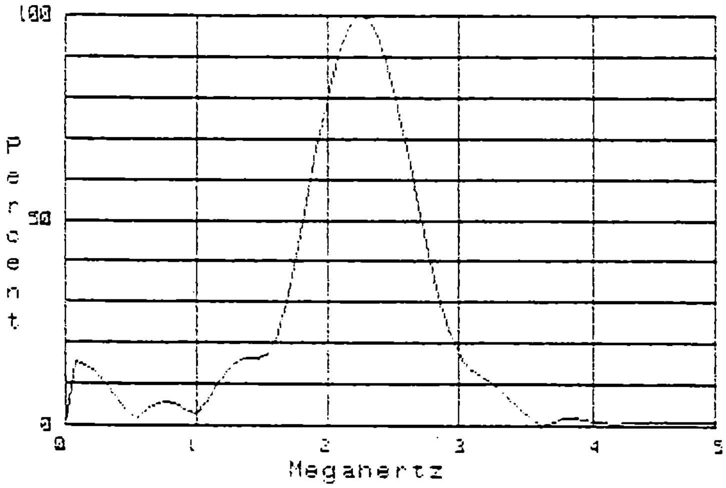
CERTIFICATION DATE: JAN 9, 1990

ANALOG SCAN

ATTEN 19.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 10, 1990
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .375

SERIAL NO: 1121
TEST ANGLE = : 0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :16   MODE = :NORM   REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.27 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC   MODEL :MARK I   SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

10 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-125

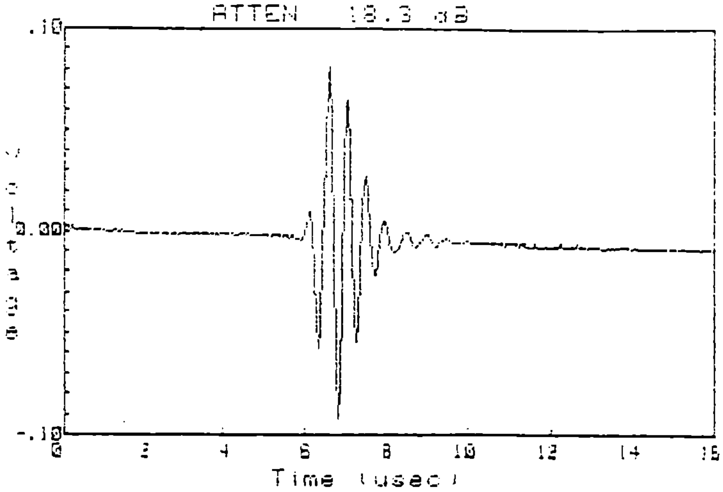
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 1121

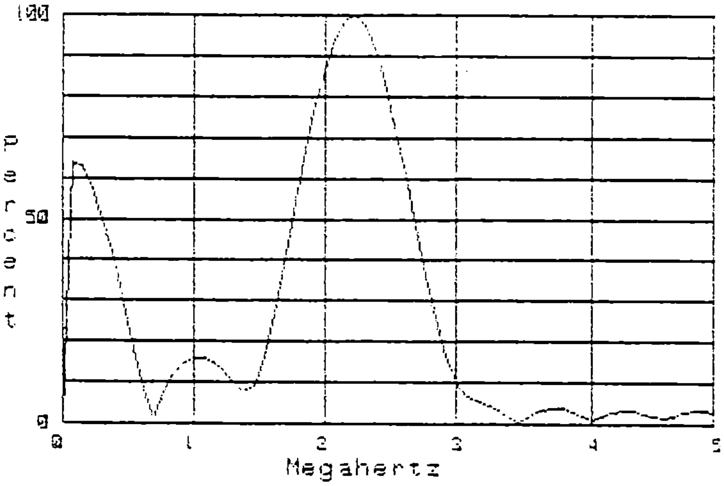
CERTIFICATION DATE: JAN 10, 1990

ANALOG SCAN

ATTEN 18.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: OCT 2, 1989

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI — SERIAL NO: 1160

CASE STYLE: RECT. — TEST ANGLE = : 0

CRYSTAL SIZE: .50 X 1.0 — FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH — MODEL: UTA-2 — SERIAL #:1214

TYPE: HP WAVEFORM RECORDER — MODEL: 5180A — SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :17 — MODE = :NORM — REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz — MEASURED FREQUENCY = : 2.27 Mhz — ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC — MODEL :MARK I — SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE BH

Bill A. Huffman

SIGNATURE

10/2/89

DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

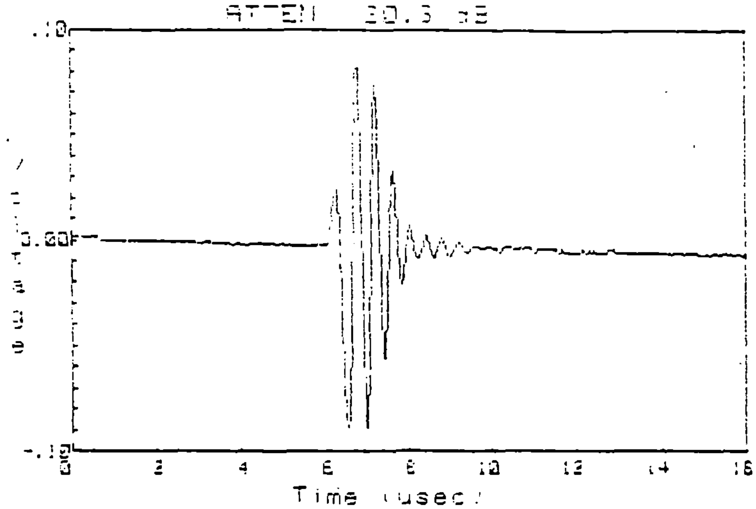
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 1160

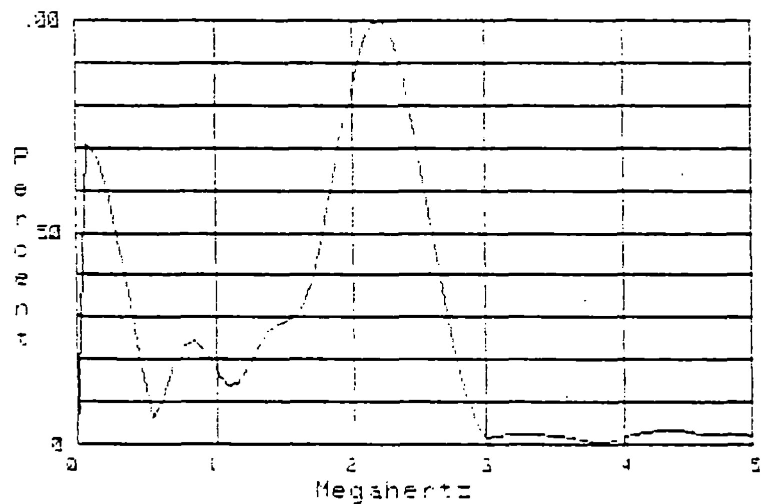
CERTIFICATION DATE: OCT 2, 1988

ANALOG.SCAN

ATTEN 30.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: MAR 6, 1990
NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI SERIAL NO: 1554
CASE STYLE: RECT. TEST ANGLE = : 0
CRYSTAL SIZE: .375 FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :15 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz
MEASURED FREQUENCY = : 2.27 Mhz
ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

3/6/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

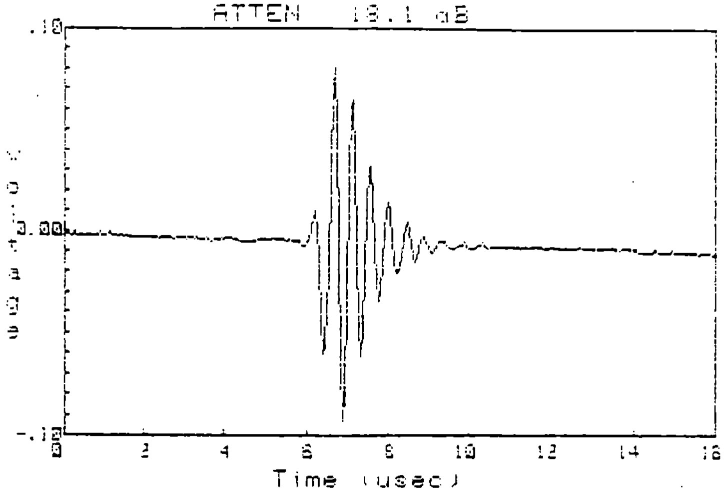
CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~[illegible]~~ IDC-NDES-116-C

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

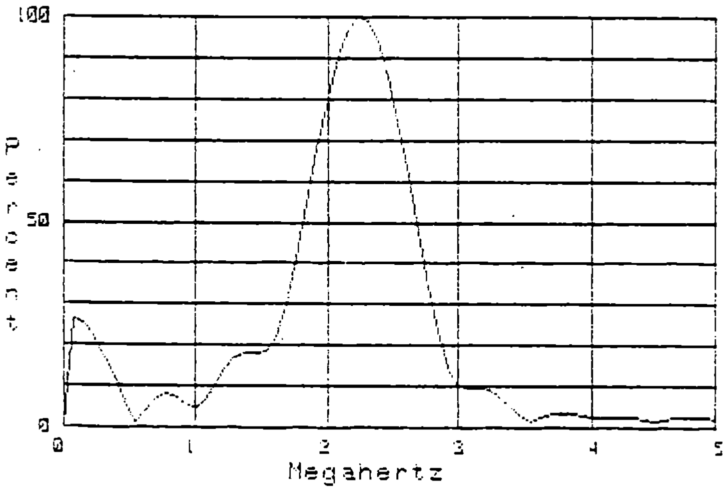
MANUFACTURE: SWRI SERIAL No: 1554

CERTIFICATION DATE: MAR 6, 1990

ANALOG SCAN
ATTEN 18.1 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: MAR 6, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .375

SERIAL NO: 1897
TEST ANGLE = : 0
FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :5 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM	MEASURED FREQUENCY	ACCEPTABLE MAXIMUM
= : 1.2 Mhz	= : 1.64 Mhz	= : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE 871

Billy H. Huffman
SIGNATURE

3/6/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XI-22-135~~ QC-NDES-116-C

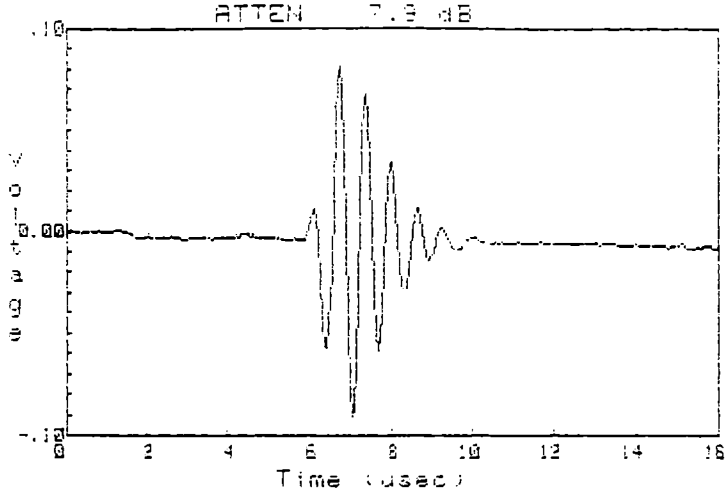
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 1897

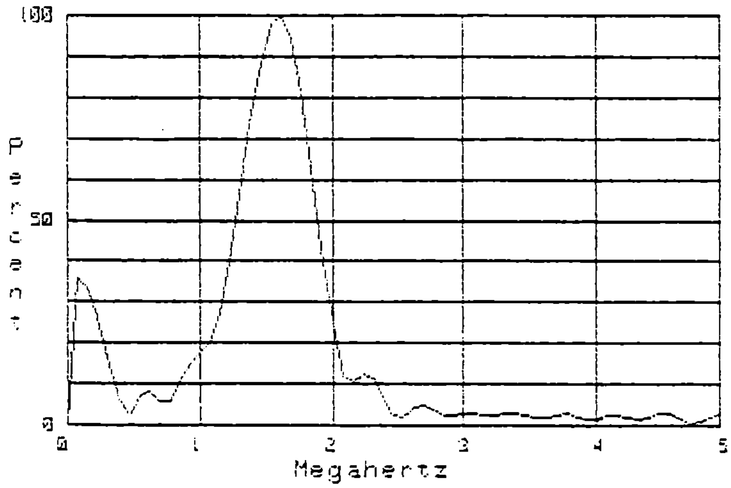
CERTIFICATION DATE: MAR 6, 1990

ANALOG SCAN

ATTEN 7.9 dB



POWER SPECTRUM



------- S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT ---------

TEST DATE: JAN 10, 1990

NAME OF OPERATOR : B. HUFFMAN

----- TRANSDUCER INFORMATION -----

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .50 X 1.0

SERIAL NO: 1907
TEST ANGLE = : 0
FREQUENCY = : 1.5

------- WAVEFORM AND POWER SPECTRUM INST. -------

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

------- UTA SETTING

ATTENUATION = :19 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

------- TARGET REFLECTOR INFORMATION ---------

PLASTIC BALL BLOCK S. D. H.

------- FREQUENCY AND SPECTRUM ANALYSIS ---------

ACCEPTABLE MINIMUM = : 1.2 Mhz
MEASURED FREQUENCY = : 1.56 Mhz
ACCEPTABLE MAXIMUM = : 1.8 Mhz

------- ULTRASONIC INST. -- DAC CURVE -------

TYPE :SONIC
MODEL :MARK I
Db SETTING :
SERIAL No. :01109E

NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

10 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

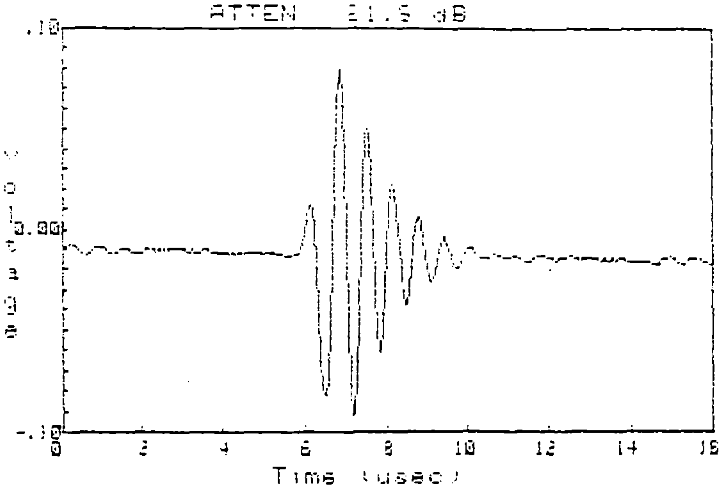
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SwRI SERIAL No: 1307

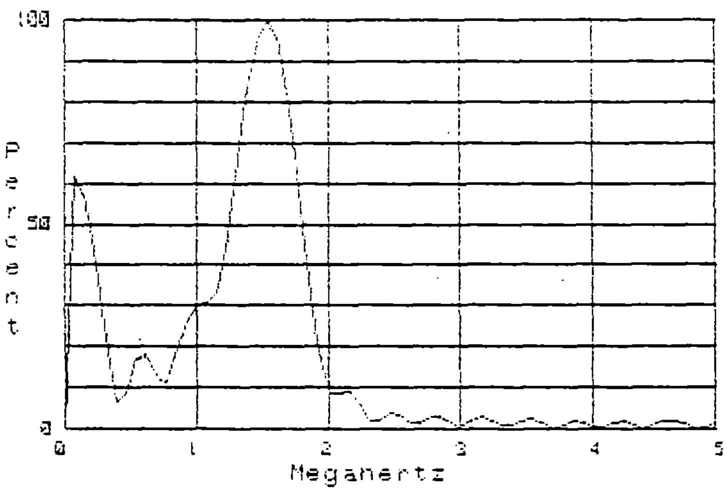
CERTIFICATION DATE: JAN 10, 1990

ANALOG SCAN

ATTEN 21.5 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 11, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .50

SERIAL NO: 1965
TEST ANGLE = : 0
FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2319A00667

UTA SETTING

ATTENUATION = :10 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.2 Mhz

MEASURED FREQUENCY = : 1.56 Mhz

ACCEPTABLE MAXIMUM = : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BJH

Billy G. Huffman
SIGNATURE

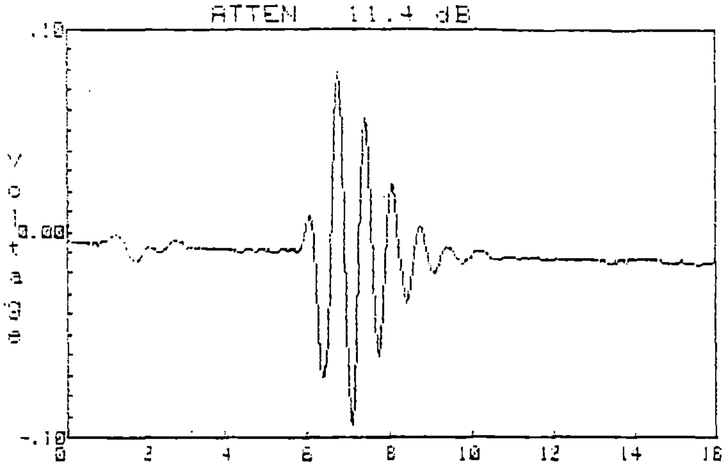
11 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

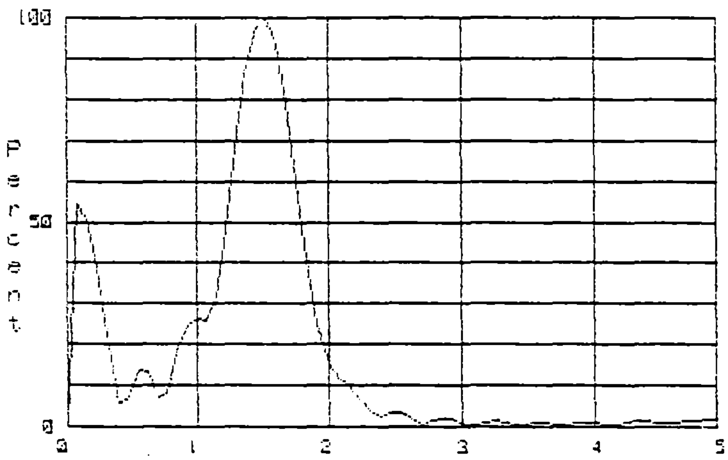
CERTIFICATION PERFORMED IN ACCORDANCE WITH NDT-FE-128

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: SWRI SERIAL No: 1965
CERTIFICATION DATE: JAN 11, 1990

ANALOG SCAN
ATTEN 11.4 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 11, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .50

SERIAL NO: 1968
TEST ANGLE = : 0
FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :10 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.2 Mhz
MEASURED FREQUENCY = : 1.56 Mhz
ACCEPTABLE MAXIMUM = : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING : NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

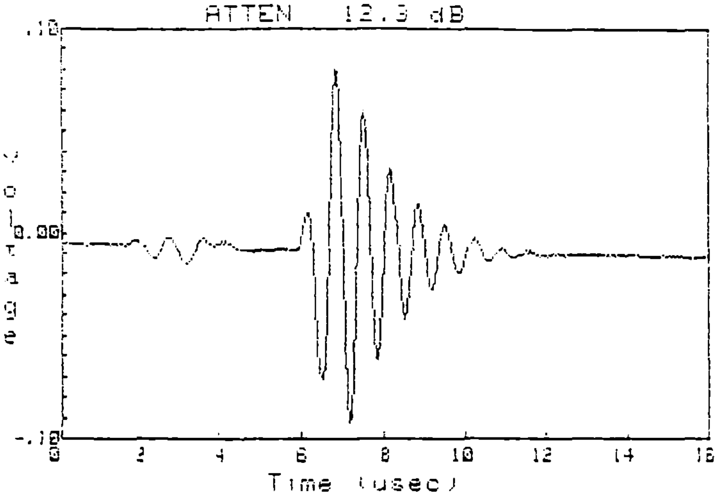
11 Jan 1990
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

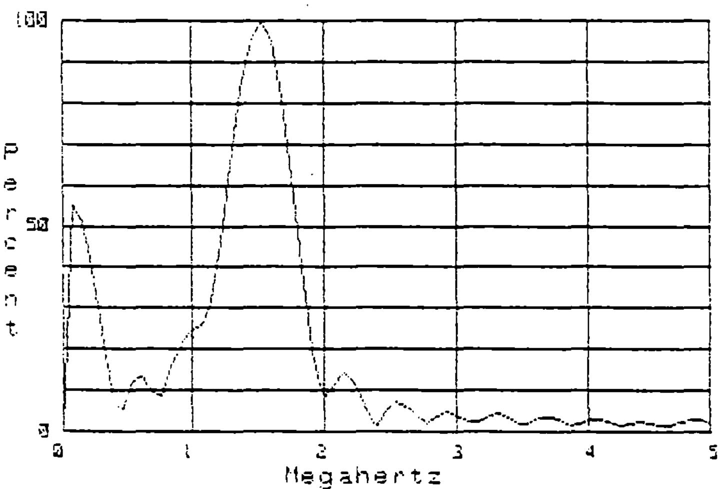
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-108

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: SWRI SERIAL No: 1968
CERTIFICATION DATE: JAN 11, 1990

ANALOG SCAN
ATTEN 12.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: FEB 20, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .50 X 1.0

SERIAL NO: 2209
TEST ANGLE = : 0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-I SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5190A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :16 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz
MEASURED FREQUENCY = : 2.27 Mhz
ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

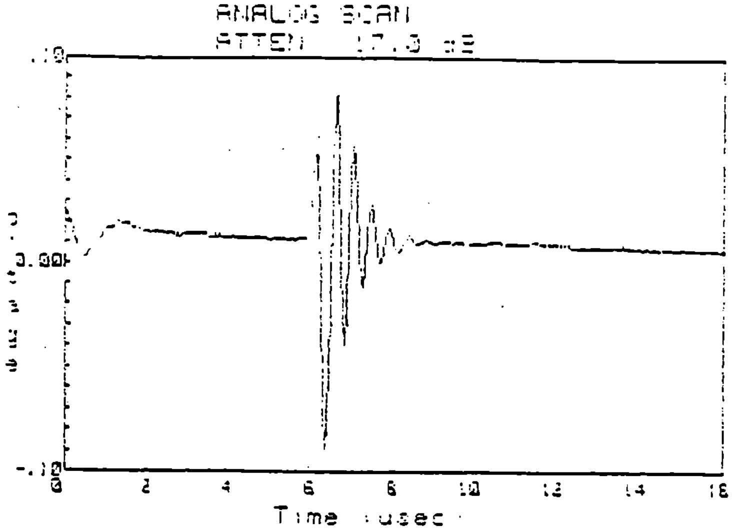
Billy G. Huffman
SIGNATURE

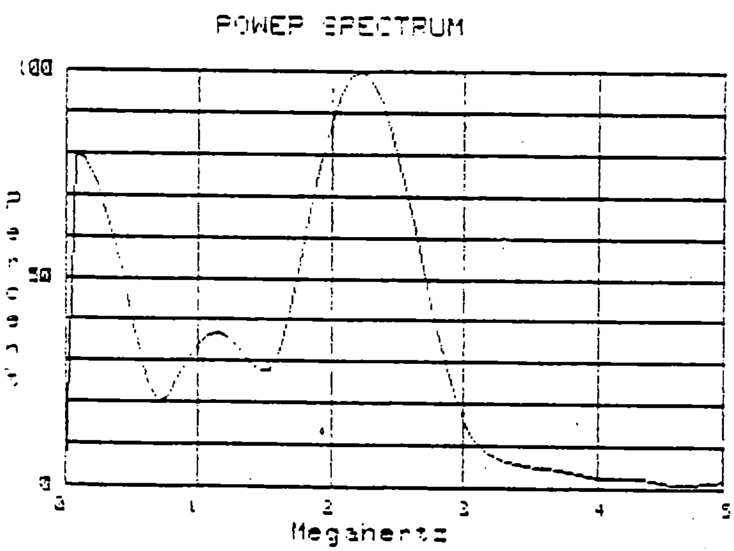
2/20/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XII-TE-120~~ 42-C-NDES-116-0

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: SWRI SERIAL No: 2209
CERTIFICATION DATE: FEB 20, 1990





S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: OCT 25, 1989 | Page 1 of 2
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI	SERIAL NO: 2545
CASE STYLE: RECT.	TEST ANGLE = : 0
CRYSTAL SIZE: .375	FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :0 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM	MEASURED FREQUENCY	ACCEPTABLE MAXIMUM
= : 1.2 Mhz	= : 1.56 Mhz	= : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

10/25/89

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

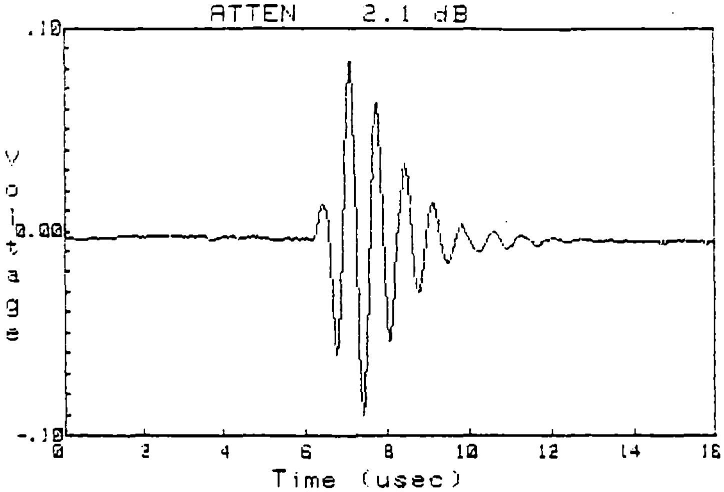
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 2545

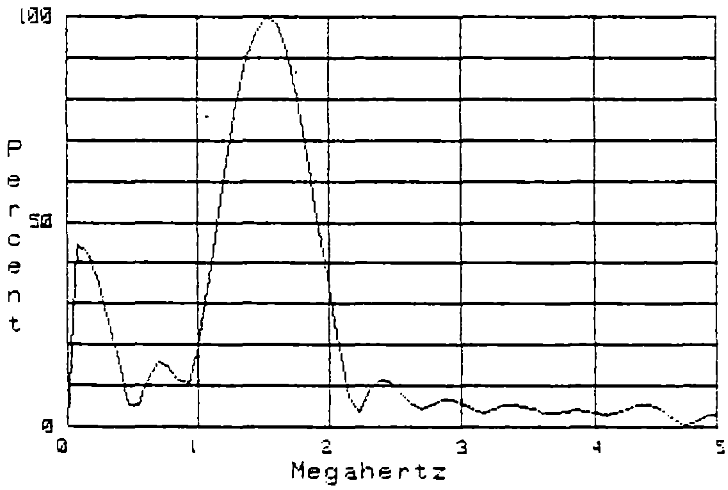
CERTIFICATION DATE: OCT 25, 1989

ANALOG SCAN

ATTEN 2.1 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: MAR 5, 1990

NAME OF OPERATOR : S. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI	SERIAL NO: 2578
CASE STYLE: ROUND DUAL	TEST ANGLE = : 0
CRYSTAL SIZE: .375	FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :11 MODE = :THRU REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER

EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

OTHER = :1 INCH SECTION ON PT 300 BLOCK.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM	MEASURED FREQUENCY	ACCEPTABLE MAXIMUM
= : 1.8 Mhz	= : 2.34 Mhz	= : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E

Db SETTING :

NOT APPLICABLE ~~~

SIGNATURE

3/5/90

DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~[illegible]~~ [illegible]

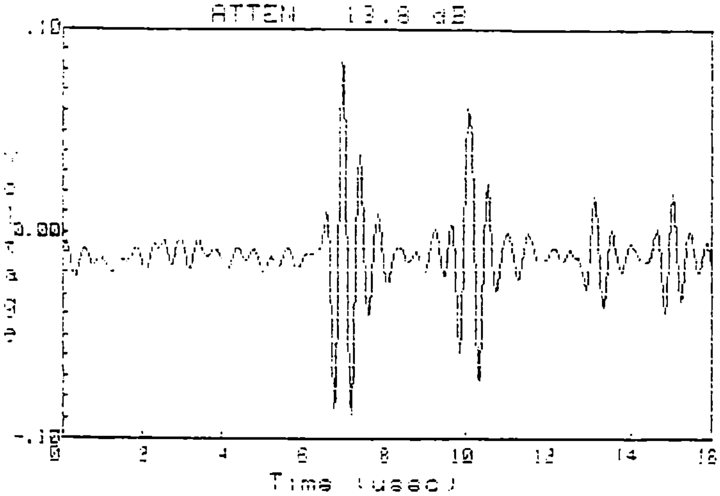
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 2578

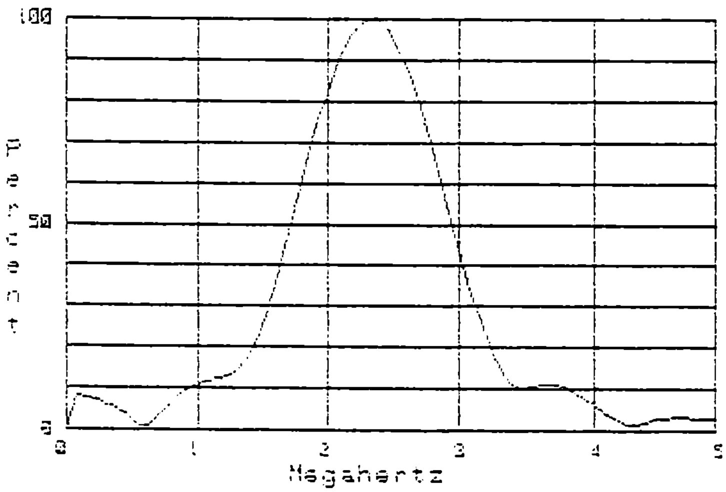
CERTIFICATION DATE: MAR 5, 1990

ANALOG SCAN

ATTEN 13.8 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: MAR 6, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .375

SERIAL NO: 2676
TEST ANGLE = : 0
FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :6 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.2 Mhz	FREQUENCY = : 1.48 Mhz	MAXIMUM = : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE XBH

Billy J. Huffman
SIGNATURE

3/6/90

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XI-TE-125~~ 2.0-NDES-116-0

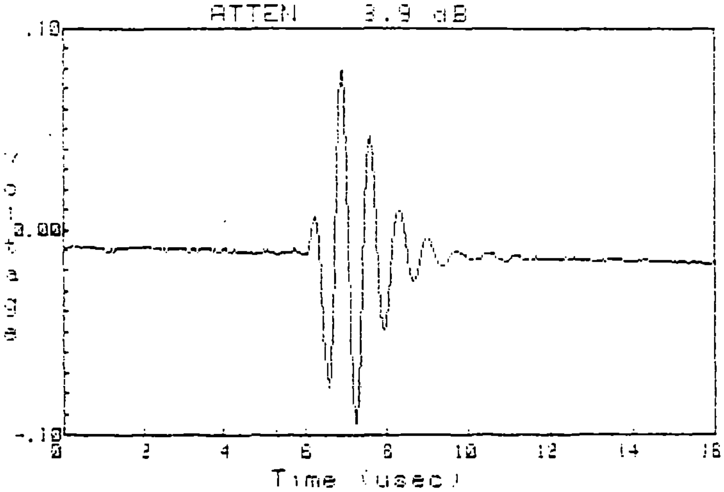
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 2576

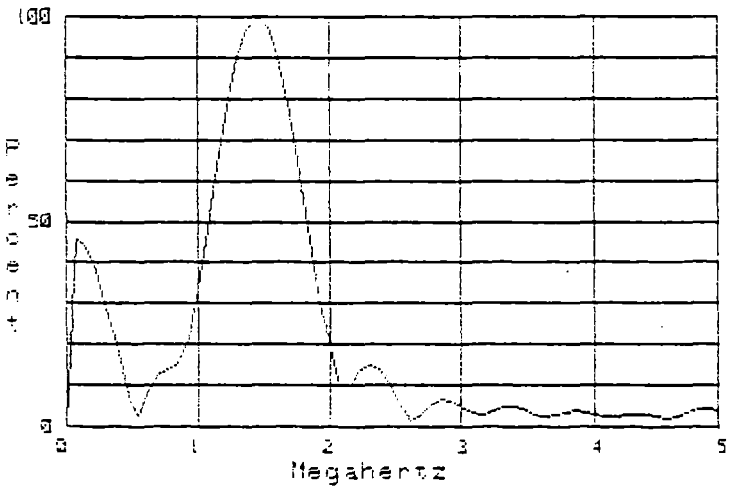
CERTIFICATION DATE: MAR 6, 1990

ANALOG SCAN

ATTEN 3.9 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: MAR 5, 1990

NAME OF OPERATOR : S. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: .375

SERIAL NO: 2678
TEST ANGLE = : 0
FREQUENCY = : 1.5

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-3 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :7 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.2 Mhz
MEASURED FREQUENCY = : 1.48 Mhz
ACCEPTABLE MAXIMUM = : 1.8 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BGH

Bill G. Huffman
SIGNATURE

3/6/90
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XII-SE-120~~ 12.0-NDES-116-0

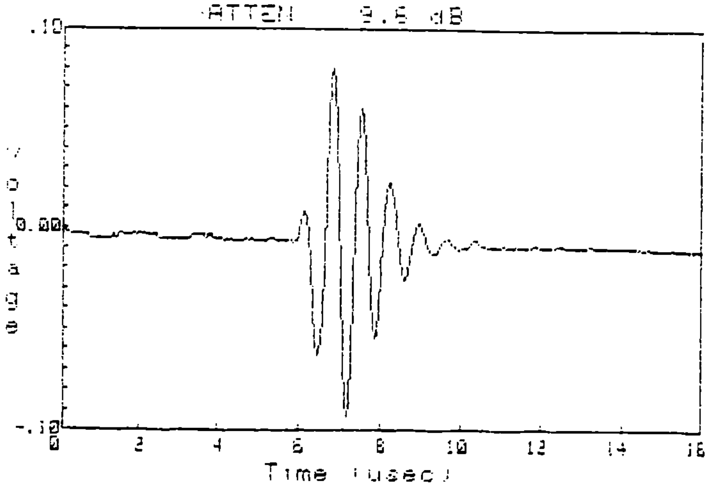
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 2578

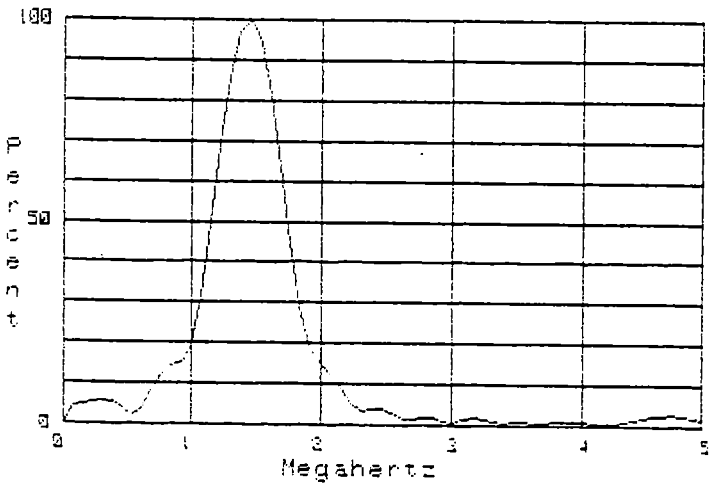
CERTIFICATION DATE: MAR 6, 1990

ANALOG SCAN

ATTEN 9.6 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: JAN 18, 1990

NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
SERIAL NO: 2893
CASE STYLE: ROUND
TEST ANGLE = : 0
CRYSTAL SIZE: 1.0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:1214
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :37 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

3/16 IN. 3/4 T HOLE IN E.E.I. BLOCK

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz
MEASURED FREQUENCY = : 2.19 Mhz
ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :47

Billy G. Huffman
SIGNATURE

1/18/90
DATE

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

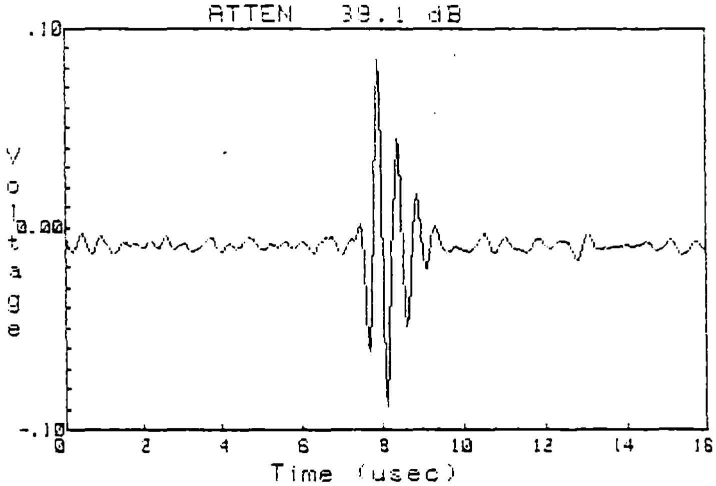
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 2893

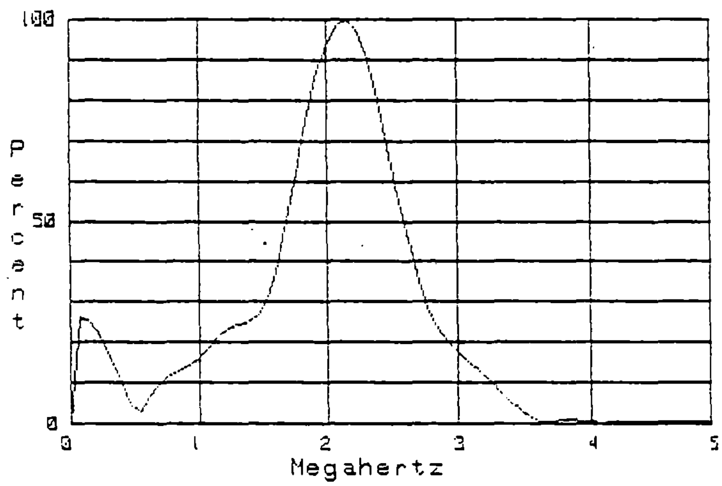
CERTIFICATION DATE: JAN 18, 1990

ANALOG SCAN

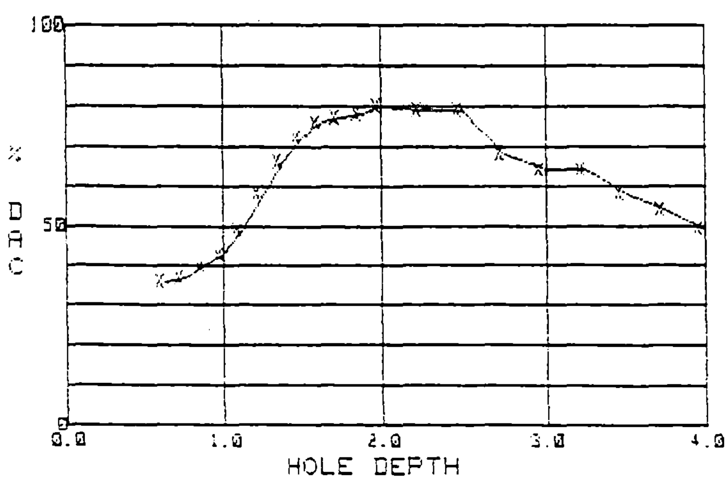
ATTEN 39.1 dB



POWER SPECTRUM



DAC CURVE



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: MAR 23, 1990
NAME OF OPERATOR : B. HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI	SERIAL NO: 2894
CASE STYLE: ROUND	TEST ANGLE = : 0
CRYSTAL SIZE: 1.0	FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :34 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

3/16 IN. 3/4 T HOLE IN E.E.I. BLOCK

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz	MEASURED FREQUENCY = : 2.11 Mhz	ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :46

Billy G. Huffman
SIGNATURE

3/29/90
DATE

CERTIFICATION PERFORMED IN ACCORDANCE WITH ~~XII-FE-126~~ WO-NDES-116-C

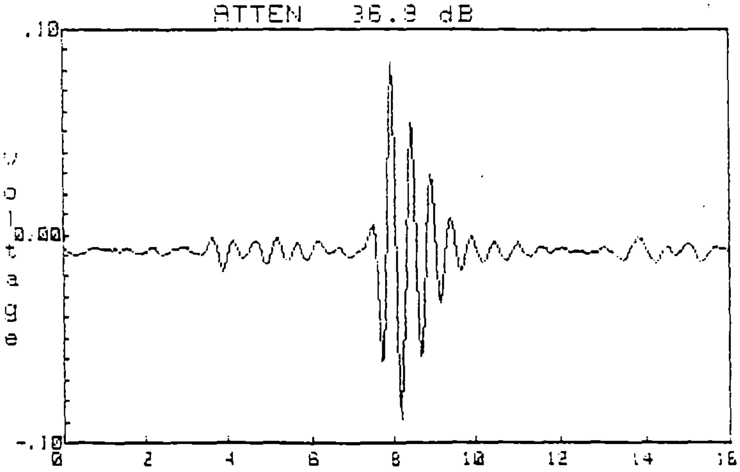
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 2894

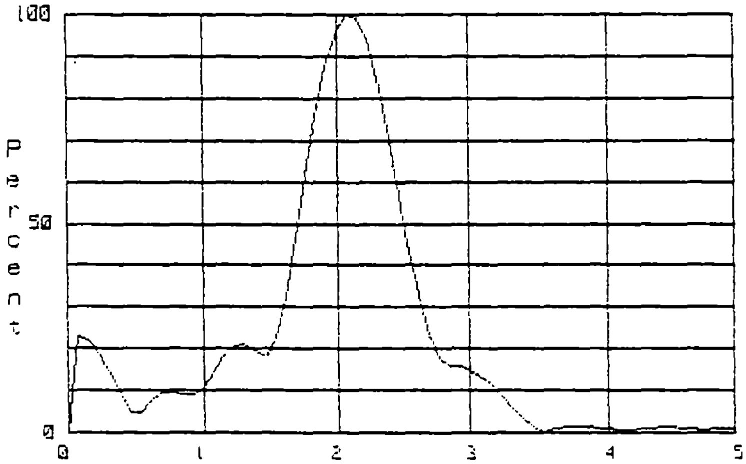
CERTIFICATION DATE: MAR 29, 1990

ANALOG SCAN

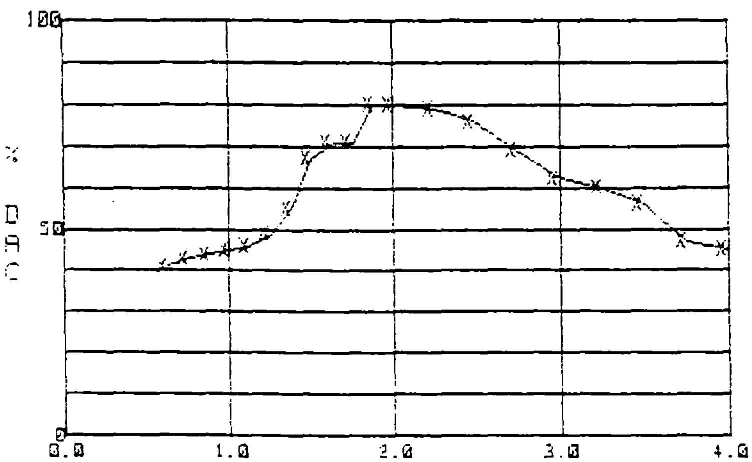
ATTEN 36.9 dB



POWER SPECTRUM



DAC CURVE



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: OCT 17, 1989 Page of 2
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI SERIAL NO: [illegible]
CASE STYLE: ROUND TEST ANGLE = : 0
CRYSTAL SIZE: .375 DUAL FREQUENCY = : 5.0

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH MODEL: UTA-2 SERIAL #:[illegible]4
TYPE: HP WAVEFORM RECORDER MODEL: 5180A SERIAL #:[illegible]8A00887

UTA SETTING

ATTENUATION = :13 MODE = :THRU REP. RATE = :[illegible]
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

OTHER = :1 INCH SECTION ON RT 200 BLOCK.

TRANSDUCER INFORMATION

ACCEPTABLE MINIMUM = : 4 Mhz MEASURED FREQUENCY = : 5.33 Mhz ACCEPTABLE MAXIMUM = : 6 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :[illegible]
Db SETTING :

NOT APPLICABLE BGH

Billy G. Huffman
SIGNATURE

10/17/89
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED I[illegible] ACCORDANCE WITH [illegible]

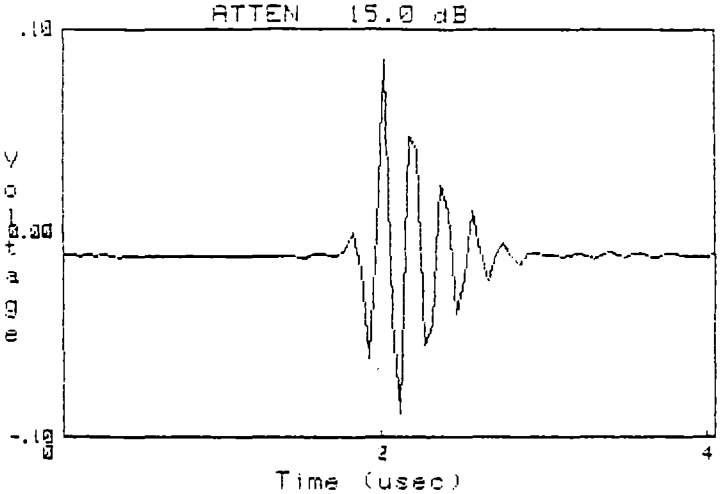
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL NO: 3013

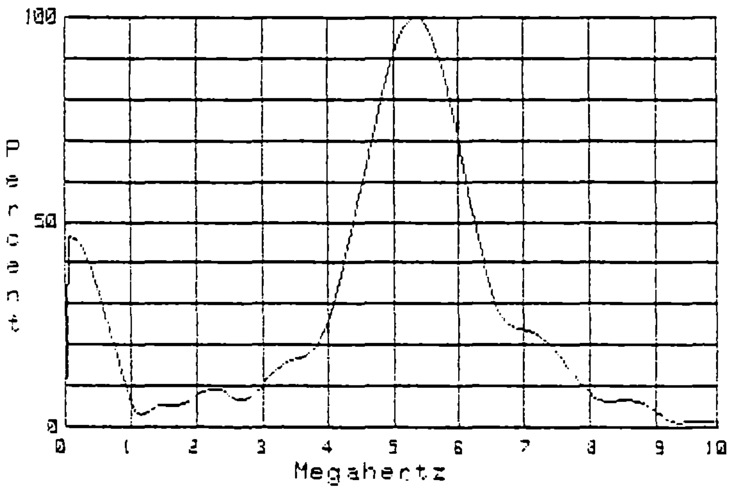
CERTIFICATION DATE: OCT 17, 1989

ANALOG SCAN

ATTEN 15.0 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: NOV 3, 1989 | Page 1 of 2

NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI | SERIAL NO: 3221
CASE STYLE: ROUND | TEST ANGLE = : 0
CRYSTAL SIZE: .250 | FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH | MODEL: UTA-2 | SERIAL #:1214
TYPE: HP WAVEFORM RECORDER | MODEL: 5180A | SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :2 | MODE = :NORM | REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE MINIMUM = : 1.8 Mhz | MEASURED FREQUENCY = : 2.03 Mhz | ACCEPTABLE MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC | MODEL :MARK I | SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Billy G. Huffman
SIGNATURE

11/3/89
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH NII-FE-126

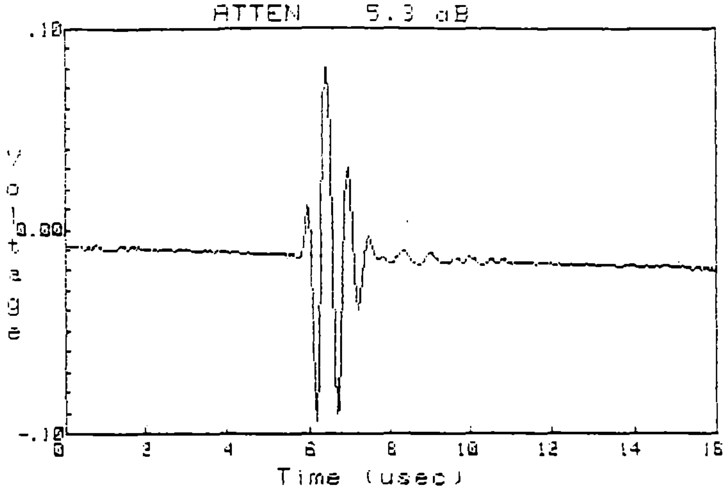
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 3221

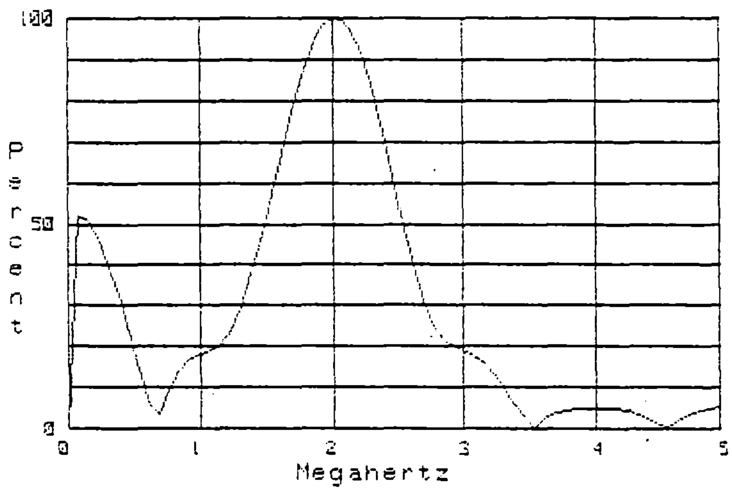
CERTIFICATION DATE: NOV 3, 1989

ANALOG SCAN

ATTEN 5.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: NOV 28, 1989
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI | SERIAL NO: 3224
CASE STYLE: ROUND | TEST ANGLE = : 0
CRYSTAL SIZE: .250 | FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :7 MODE = :NORM REP. RATE = :015
EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 2.27 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE BH

Billy O. Huffman
SIGNATURE

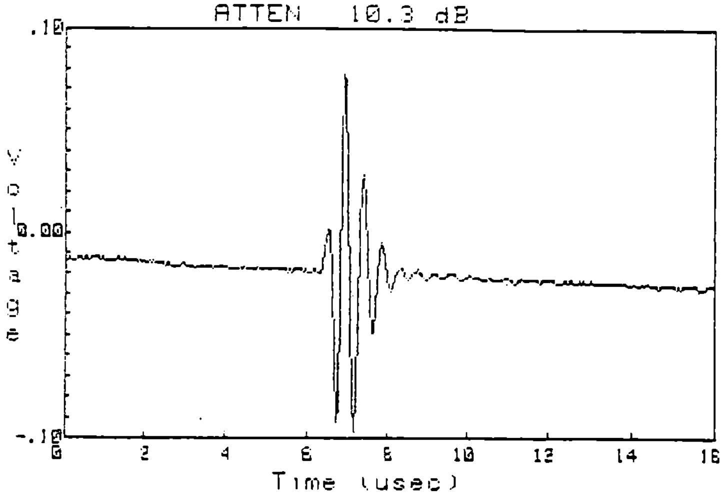
27 Nov 1989
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

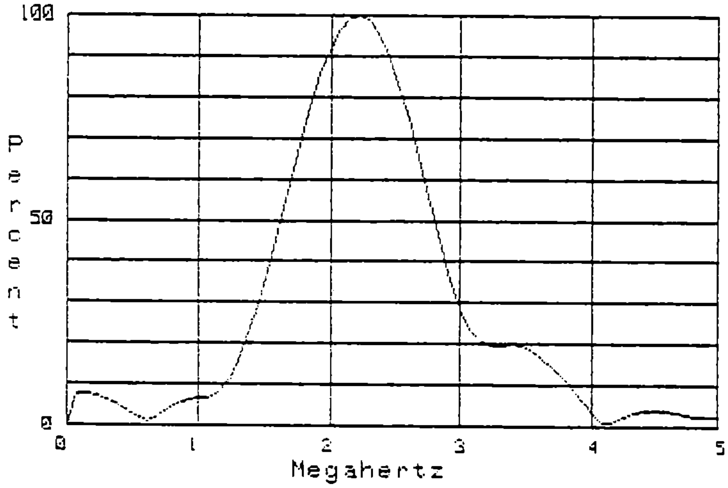
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-12E

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: SWRI SERIAL No: 3224
CERTIFICATION DATE: NOV 28, 1989

ANALOG SCAN
ATTEN 10.3 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: SEPT 14, 1989

NAME OF OPERATOR : G.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE: SWRI
CASE STYLE: RECT.
CRYSTAL SIZE: 1.0

SERIAL NO: 3672
TEST ANGLE = : 0
FREQUENCY = : 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :17 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 1.95 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db SETTING :

NOT APPLICABLE GH

Gilf G. Huffman
SIGNATURE

9/14/89
DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-105

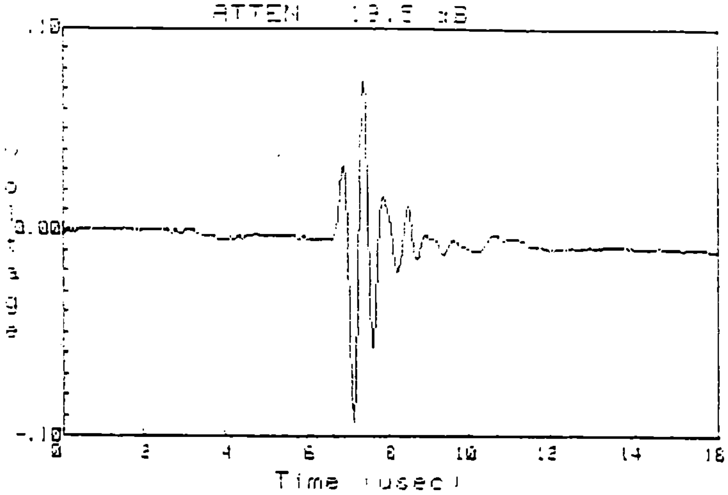
S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

MANUFACTURE: SWRI SERIAL No: 3570

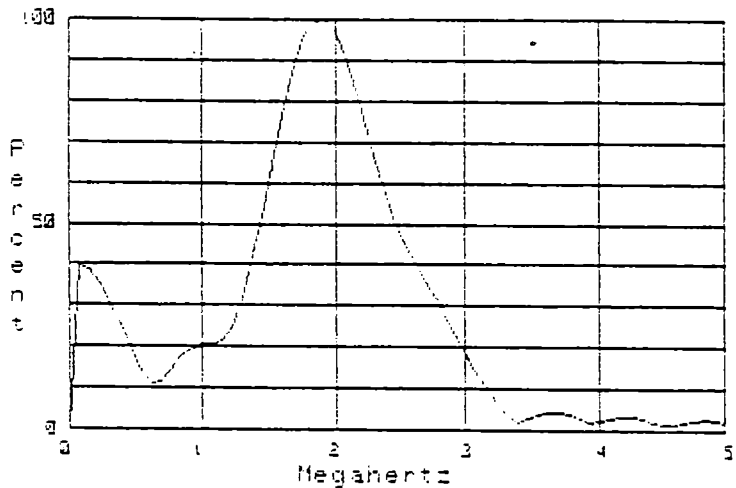
CERTIFICATION DATE: SEPT 14, 1988

ANALOG SCAN

ATTEN 13.5 dB



POWER SPECTRUM



S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT

CERT DATE: SEPT 14, 1989
NAME OF OPERATOR : B.HUFFMAN

TRANSDUCER INFORMATION

MANUFACTURE:	SWRI	SERIAL NO:	3678
CASE STYLE:	RECT.	TEST ANGLE =	: 0
CRYSTAL SIZE:	1.0	FREQUENCY =	: 2.25

WAVEFORM AND POWER SPECTRUM INST.

TYPE: AEROTECH	MODEL: UTA-2	SERIAL #:1214
TYPE: HP WAVEFORM RECORDER	MODEL: 5180A	SERIAL #:2318A00667

UTA SETTING

ATTENUATION = :16 MODE = :NORM REP. RATE = :015

EXT. & INT. PULSER : = Switch to INT PULSER
EXT. & INT. PULSER : = Switch to INT TRIGGER

TARGET REFLECTOR INFORMATION

PLASTIC BALL BLOCK S. D. H.

FREQUENCY AND SPECTRUM ANALYSIS

ACCEPTABLE	MEASURED	ACCEPTABLE
MINIMUM = : 1.8 Mhz	FREQUENCY = : 1.95 Mhz	MAXIMUM = : 2.7 Mhz

ULTRASONIC INST. -- DAC CURVE

TYPE :SONIC MODEL :MARK I SERIAL No. :01109E
Db.SETTING :

NOT APPLICABLE

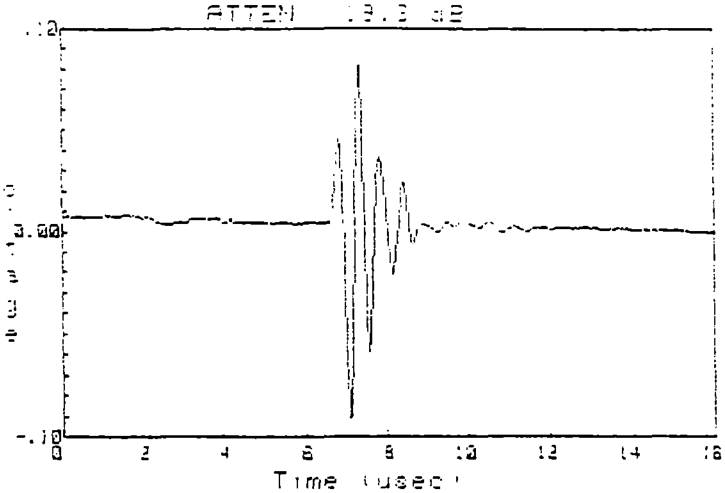
SIGNATURE 9/14/89 DATE

NO D/A PLOT REQUIRED ON TRANSDUCER TO BE MOUNTED ON A WEDGE AND/OR USED AS ANGLE BEAM.

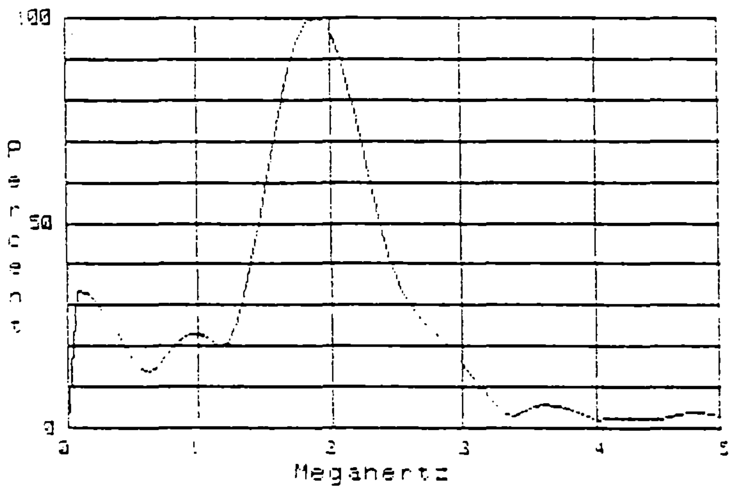
CERTIFICATION PERFORMED IN ACCORDANCE WITH XII-FE-126

S.W.R.I. ULTRASONIC TRANSDUCER ANALYSIS REPORT
MANUFACTURE: SwRI SERIAL No: 2578 PAGE 2 of 2
CERTIFICATION DATE: SEPT 14, 1993

ANALOG SCAN
ATTEN 18.3 dB



POWER SPECTRUM



APPENDIX G

CUSTOMER NOTIFICATION FORMS

SOUTHWEST RESEARCH INSTITUTE

CUSTOMER NOTIFICATION FORM

Project No. 17-3373 Site: SALEM 2 CNF Serial No. 90-1

Examination Area: RPV VISUALS Procedure No. SAMZ-VT1

PART I - SwRI Finding

Comments: 5 LINEAR INDICATIONS RANGING FROM 1/2" to 1 1/4" IN LENGTH. SEE ATTACHED DATA SHEET

Attachments: VT DATA SHEET Z80013

SwRI Signature: John R. Ozamells Date: 5/7/90

PART II - CNF Received By

Customer Signature: C.J. Conne Date: 5/8/90

PART III - Disposition by Customer

Comments: per disposition of DR SMT90-144 USE AS IS FOR ONE FUEL CYCLE. REEXAMINE DURING UNIT 2 6th refueling outage under W.O. 900514122 to determine actual size and growth so a method of indication removal/repair can be determined. Safety Evaluation on file with IST.

Customer Signature: CJ Conne Date: 6-7-90

PART IV - Reexamination

Comments: DURING UNIT 2 6th refueling outage per W.O. 900514122.

Attachments: DR SMT 90-144, WO 900514122

SwRI Signature: John R. Ozamells Date: 6-12-90

PART V - CNF Closed By

Customer Signature: CJ Conne Date: 6-7-90

SwRI Form NDTR-CNF-1, Rev. 2

NUCLEAR DEPARTMENT
STATION DEFICIENCY REPORT

DR # SMT-90-144
WO/WR # 900514122

IDENTIFICATION:

S1_ S2 X SC_ HC_

Component U/2 Rx. Vessel Sys/Code RC Serial # 67101 (Vessel)
Model # ______ ASME Code Item? Y X N _

Description of Nonconforming Item:
VISUAL EXAMINATION OF UNIT 2 REACTOR VESSEL INTERIOR IN ACCORDANCE WITH ASME SECTION XI, 1974 Edition through Summer 1975 Addenda Examination Category B-N-1 REVEALED FIVE LINEAR INDICATIONS. THEY ARE LOCATED AS FOLLOWS:
INDICATION #1 - 3/4" LONG - 24 5/6 H.L. NOZZLE APPROX. 358° with Zero @ center of nozzle
INDICATION #2 - 1 1/4" Long - 24 5/6 H.L. NOZZLE LOCATED AT 0° (Top or center of nozzle)
INDICATION #3 - 3/4" Long - core barrel circ. weld Approx 355° transverse to weld
Indication # 4 - ≈1" Long approx 1 1/4" below circ weld of core barrel - 0°
indication #5 - 1/2" Long - core barrel circ weld approx 357° transverse to weld

CJ Conne	5-7-90	N/A	N/A	N/A	A.R. Mann	5/7/90
Supvr/Planner	Date	LCO #	Time	Date	SNSS/NSS	Date

DISPOSITION:

REPAIR _ NUC. CODE COMP. REPAIR _ NUC. CODE COMP. MODIFICATION _
USE-AS-IS _ NUC. CODE COMP. REPLACMNT _ ASME VESSEL REPAIR (NON-NUC.) _
OTHER X Interim Disposition use-As-is 1 Fuel cycle.

10CFR50.59 Safety Eval. Req'd? Y ✓ N _ 10CFR21 Applies? Y _ N _
Temp Mod/Design Change Req'd? Y _ N ✓ Temp Mod/Change Pkge # N/A
Future Item Replacement Req'd? Y _ N _ WO # ______
Instructions:

Interim disposition: use As is For one Fuel cycle between 5Th. refueling and 6Th. refueling at which Time 10 year ISI is scheduled. Reexamine at 10 year ISI To determine actual Size and ~~groth~~ growth if any so That method of indication removal/repair can be determined. Workorder 900514122 has been generated To control work required by This DR. The indications identified above have been evaluated and found not To be a concern for operation or nuclear safety. This DR shall not be cancelled without concurrence of Tech. Dept., SQA, and The ANII.

RR 5/14/90

EJ Rmane	5/14/90		
E&PB Eng.	Date	System Eng.	Date

REVIEW:

SQA	DATE	*Req'd (ASME Code Items)	ANII*	Date

ACTION COMPLETE: Cause Code: ______

Job Supervisor	Date	SQA	Date	ANII*	Date

```
COMMAND INPUT ===> ________                                        CREATE MODE

WORK ORDER NO   : __900514122        W/O STATUS-DATE: PLNCPT 05/14/90 W/O PRTD: _
WORK REQUEST NO: ___________         LAST UPDATE-BY: 05/14/90 CJC NO. OF ACTS: 01
INIT DEPT       : NSS_ SMT           INITIATOR : C.J.CONNER-2058_____ 05/14/90
TASK-TYPE       : CM CM__            PRIORITY  : 01
  SP DEPT       : NSS_ SMT
ACTION STATMNT  : ___________        A S DATE-TIME: ________ _____
SYSTEM          : ISI MUC: C         UNIT-CMPNT ID: S2 2ISI-SWR_______________
FEG NUMBER      : _______________    CMPNT TYPE: M MISC
F/CMP DESCR: SOUTHWEST RESEARCH ISI LONG TERM PLAN____________________________
LOCATION        : 15130012 REACTOR VESSEL HEAD AREA       CAN 2________________
W/O SUMMARY     : REINSPECTION OF U/2 RX. VESSEL INDICATIONS______
W/O DESCRIPTION: DURING THE UNIT 2 6TH REFUELING, 10 YR. ISI OUTAGE, PLEASE___
 REINSPECT THE SUSPECT LINEAR INDICATION ON THE RX. VESSEL CORE BARREL NOTED__
 DURING THE U/2 5TH REFUELING OUTAGE RX. VESSEL VISUAL EXAMINATION. INDICATION
 SIZE AND DEPTH TO BE DETERMINED VIA PAR MECHANISM AND/OR VISUAL EXAMINATION._
PROCESS TYPE    : CM_                REJECTED BY : ____________________ ________
REFERENCE NO    : _______________    ASGND PLNR  : C.J. CONNER-2058____ 05/14/90
                                     RESP SUPV   : C.J.CONNER-2058_____ 05/14/90
PLND W/O START : 10/01/91            DCR NUMBER  : ___ - _____ - _ PKG# : _____
STATUS COMMENTS: _______________________________________________
MESSAGE: VALID CMMDS: REQ/COMP/ACT/PRINT


-------------------------- WORK ORDER REQUIREMENTS -----------------PAGE 2 OF 2
COMMAND INPUT ===> ________                                        CREATE MODE
WORK ORDER NO: __900514122                 W/O STATUS-DATE: PLNCPT 05/14/90
UNIT-CMPNT ID: S2 2ISI-SWR________________ FEG NUMBER      : _______________
W/O SUMMARY   : REINSPECTION OF U/2 RX. VESSEL INDICATIONS______
==============================================================================
SY RLTD/QAR     : SR_ SAFETY CLASS/QGC: 1__ SEIS: 1______ EQ: N___ WK. CLASS: S
REQD IN MODES   : _ _ _ _ _ _    REPAIR MODES     : _ _ _ _ _ _    QA. REQD : Y
CMPNT UPDATE    : N (Y/N)        CLARIFIERS       : __ __
NPRDS RPTBL     : N (Y/N)        BOM/PARTS UPDATE: N (Y/N)     OUTAGE REQMNT: Y__
INTERRUPTABLE   : Y (Y/N)        SYSTEM OUTAGE    : ____
REFERENCES      : ____________________ ____________________ ____________________

RETEST REQD     : N (Y/N)        RETEST MODE      : _          RETEST DEPT.: ____
RETEST REQMNTS  : ____________________________________________________________
                  ____________________________________________________________
                  ____________________________________________________________
EST$: ________400    ACT$   : __________
========================== SPECIAL INSTRUCTIONS ==============================
INSPECTION REQUIRED PER DISPOSITION OF DR SMT90-144.  ENGINEERING TO BE______
NOTIFIED OF RESULTS OF REINSPECTION._________________________________________
_____________________________________________________________________________

MESSAGE: VALID CMMDS: ACT/COMP/PF4
```

COMMAND INPUT ===> _________ CREATE MODE
COPY ACTIVITY FROM WORK ORDER NO: ___________ LAST UPDATED: 05/14/90 BY: CJC
ACTIVITY NO: __
WORK ORDER NO: __900514122 W/O STATUS: PLNCPT RECUR TASK NUMBER: ______
ACTIVITY NO : 01 OF 02 ACT STATUS: PC 05/14/90 PRINTED: _ TIMES PRINTED: __
IT-CMPNT ID: S2 2ISI-SWR_________________ ASSIGNED PLNR: C.J. CONNER-2058____
RESP DEPT : NSS_ SMT ACTIVITY TYPE: FW RESP. SUPV. : C.J.CONNER-2058_____
TOTAL DURATION: _10.0 SCHED DATE: 10/01/91 SYSTEM: ISI
PLND ACT START: 09/03/91 COMMENTS: ____________________
ACT SUMMARY : REINSPECTION OF U/2 RX. VESSEL INDICATIONS______
ACT DESCRP: DURING THE UNIT 2 6TH REFUELING, 10 YR. ISI OUTAGE, PLEASE________
REINSPECT THE SUSPECT LINEAR INDICATION ON THE RX. VESSEL CORE BARREL NOTED__
DURING THE U/2 5TH REFUELING OUTAGE RX. VESSEL VISUAL EXAMINATION. INDICATION
SIZE AND DEPTH TO BE DETERMINED VIA PAR MECHANISM AND/OR VISUAL EXAMINATION._
IN PREMIS: _ AUTO UPDT: _ SYSTEM OUTAGE: ____ ACT ID: ________________
PRINT: PLAN SHEET: Y ACTIVITY LIST : Y COMPONENT LIST: _
VALVE CARD: _ BREAKER/RELAY DATA: _
ICD CARD : _ ICD NO: 000 FAILED RETEST: _

HOLD TYPES - HA: _ HD: _ HE: _ HP: _ PH: _ PS: _
COMMENT: ______________________________________ DATE: ________ INIT: ___

MESSAGE: COMP/REQ/NEWACT/DELACT/NEXT/PER/LABOR/PART/PSHEET/TOP/BOT/PF7/PF8/PF4

--------------------- WORK ORDER ACTIVITY PLANNING -----------------PAGE 3 OF 5
COMMAND INPUT ===> ________ CREATE MODE

WORK ORDER NO: __900514122 W/O STATUS: PLNCPT RECUR TASK NO.: _______
ACTIVITY NO : 01 ACT STATUS: PC NO. OF ACTS : 02
IT-CMPNT ID: S2 2ISI-SWR_________________ ASSIGNED PLNR: C.J. CONNER-2058____
.CATION : _____________________________________ RESP DEPT : NSS_ SMT
ACT SUMMARY : REINSPECTION OF U/2 RX. VESSEL INDICATIONS______
ACT DESCRP: DURING THE UNIT 2 6TH REFUELING, 10 YR. ISI OUTAGE, PLEASE________
REINSPECT THE SUSPECT LINEAR INDICATION ON THE RX. VESSEL CORE BARREL NOTED__
DURING THE U/2 5TH REFUELING OUTAGE RX. VESSEL VISUAL EXAMINATION. INDICATION
SIZE AND DEPTH TO BE DETERMINED VIA PAR MECHANISM AND/OR VISUAL EXAMINATION._
DISTANCE FROM FLOOR : _____ FT. ACCESSABILITY: __________________
STATION SERVICES AVAILABLE WITHIN STATED DISTANCE:
120V: _____ FT. 440V: _____ FT. CA: _____ FT. SA: ____ FT. DM WTR: ____ FT
WORK IN CONJUNCTION WITH: RECURRING TASK 290002.__________________________
================================ REMARKS ===================================
CM WORK ORDER REQUIRED AS ACTIVE COPY OF RECURRING TASK 290002 WO WAS NOT____
COMPLETED AND PER DR DISPOSITION, A WORK ORDER NEEDED TO BE REFERENCED FOR___
REINSPECTION.____

MESSAGE: VALID CMMDS: PF4 RETURNS TO W/O ACTIVITY PAGE 1 OR LABOR/PARTS

SOUTHWEST RESEARCH INSTITUTE

CUSTOMER NOTIFICATION FORM

Project No. 17-3373 Site: SALEM 2 CNF Serial No. 90-2

Examination Area: VARIOUS Procedure No. NA

PART I - SwRI Finding

Comments: LIMITATION CHANGES - SEE ATTACHED LISTING

Attachments:

SwRI Signature: John R. Granville Date: 6/12/90

PART II - CNF Received By

Customer Signature: Date:

PART III - Disposition by Customer

Comments:

Customer Signature: Date:

PART IV - Reexamination

Comments:

Attachments:

SwRI Signature: Date:

PART V - CNF Closed By

Customer Signature: Date:

SwRI Form NDTR-CNF-1, Rev. 2

SALEM 2 1990 ISI LIMITATION CHANGES

SUMMARY #	WELD	CHANGE
073500	31-RC-1230-4LUI	NO LIMITATION ENCOUNTERED PSI HAD LIMITING PIPE RESTRAINT
073600	31-RC-1230-4LUO	
078000	31-RC-1210-4LUI	NO LIMITATION ENCOUNTERED ISI PSI HAD LIMITING LUG
078100	31-RC-1210-4LUO	"
183000	3-SJ-1292-5	NO LIMITATION ENCOUNTERED DURING ISI PSI HAD ELBOW LIMITATION
183050	3-SJ-1292-6	"

SOUTHWEST RESEARCH INSTITUTE
CUSTOMER NOTIFICATION FORM

Project No. 17-3373 Site: SALEM 2 CNF Serial No. 90-03

Examination Area: 24-MS-167 Procedure No. SAM2-VT1

PART I - SwRI Finding

Comments: UPPER SET OF STUDS AND NUTS HAS HEAVY CHEMICAL BUILD UP OF HARD YELLOW PLASTIC LIKE SUBSTANCE

Attachments: VT-SHEET 280006

SwRI Signature: JR Ingamells Date: 5/11/90

PART II - CNF Received By

Customer Signature: CJ Conn Date: 5/11/90

PART III - Disposition by Customer

Comments: WORK REQUEST A0089163 written to Salem MAINTENANCE to CLEAN UP STUDS AND NUTS. BUILDUP APPEARS TO BE OIL FROM MS167 VALVE. PER DECISION MADE FROM SYSTEM ENGINEER DOUG MCCOULLUM AND STATION MANAGEMENT WORK WILL BE PERFORMED DURING A LATER OUTAGE WHEN MONIES CAN BE BUDGETED

Customer Signature: CJ Conn Date: 6-7-90

PART IV - Reexamination

Comments: N/A CJC.

Attachments: WORK REQUEST A0089163

SwRI Signature: John R Ingamells Date: 6-12-90

PART V - CNF Closed By

Customer Signature: CJ Conn Date: 6-7-90

SwRI Form NDTR-CNF-1, Rev. 2

PSEG PSEG PSEG PSEG PSEG

NUCLEAR DEPARTMENT WORK REQUEST

W.R. A 0089163

IDENTIFICATION

STATION	UNIT	INIT. DEPT.	RESP. DEPT.	REQUEST PRI	T.S./A.S. NUMBER
Salem - 2	2	NSS-SMT	SMD	01	

COMPONENT ID	EQUIPMENT DESCRIPTION	EQUIPMENT LOCATION
24-MS-167	M.S. Stop Valve	Outer MS Penetration

DESCRIPTION OF MALFUNCTION Upper set of studs and nuts has a heavy chemical buildup of a hard yellow plastic like substance. This needs to be removed for stud inspection.

EMIS HUNG: YES ____ NO ✓ Tag #____ C.R. INST.: YES ____ NO ____

DATE WRITTEN	INITIATOR & EXT.	PHOTOBADGE #
5-14-90	Jim D.Marzo 2058	02-183

PROBLEM INVESTIGATION

REJECT ____ ACCEPT ____ W.O. REQ'D. YES ____ NO ____ W.O. # ____

ACTUAL PRIORITY ____ ____ PLANNER ____ DATE

WORK CLASSIFICATION

SFTY. RLTD./QAR ____ SAFETY CLASS/QGC ____ SEIS ____ EQ ____ QA REQ'D. ____

CLEANLINESS CLASS ____ PERSON CLASSIFYING ____

PERFORMING THE WORK

SS PERM. REQ'D. YES ____ NO ____

PROCEDURE(S): NAME ____ ____ DATE

WORK PERFORMED:

RWP # ____

PROG. PLN.: ____ M&TE #'S ____

AUTH.: ____ DR #'S ____

ACCOUNT: ____ ____ PERSON COMPL. WORK ____ DATE

CLOSEOUT

OPERABILITY RESTEST REQUIRED YES ____ NO ____

OPERABILITY RETEST REQUIREMENTS:

OPERABILITY RETEST COMPLETE YES NO

SOUTHWEST RESEARCH INSTITUTE

CUSTOMER NOTIFICATION FORM

Project No. 17-3592 Site Westinghouse El.Mag.Div. CNF Serial No. SAM2-FW-001

Examination Area: RCP 22 Flywheel Procedure No. SAM2-PT-1

PART I - SwRI Finding

Comments: During PT examinations on the above component, numerous indications were observed in the keyways of the bore. These were recorded into 21 different groups due to the size and type of indications. These indications were recorded on SwRI Liquid Penetrant Examination Record No.'s 110002, 110003, and 110004.

These indications were seen during the 1983 examination of the flywheel.

Attachments: Data Sheet No's 110002, 110003, 110004, dwgs. of Flywheel.

SwRI Signature: [signature] Date: 21 JUNE 90

PART II - CNF Received By

Customer Signature: ______ Date: ______

PART III - Disposition by Customer

Comments: ______

Customer Signature: ______ Date: ______

PART IV - Reexamination

Comments: ______

Attachments: ______

SwRI Signature: ______ Date: ______

PART V - CNF Closed By

Customer Signature: ______ Date: ______

SwRI Form NDTR-CNF-1, Rev. 2

APPENDIX H

SOUTHWEST RESEARCH INSTITUTE IMPLEMENTATION OF REGULATORY GUIDE 1.150

SOUTHWEST RESEARCH INSTITUTE IMPLEMENTATION OF REGULATORY GUIDE 1.150 REQUIREMENTS

The following is a transcript of Appendix A to Regulatory Guide 1.150, Revision 1, annotated with SwRI comments. These comments identify SwRI's technical methods of implementing the Regulatory Guide. Comments are made relative to the Regulatory Position portion of the Regulatory Guide only, as this is the portion to which the Nuclear Regulatory Commission (NRC) will audit for compliance.

Ultrasonic examination of reactor vessel welds should be performed according to the requirements of Section XI of the ASME B&PV Code, as referenced in the Safety Analysis Report (SAR) and its amendments, supplemented by the following:

1. INSPECTION SYSTEM PERFORMANCE CHECKS

The conduct of a quality examination requires that the performance characteristics of the inspection system used be well defined and documented. This is particularly true for situations which require comparisons of examination results generated during successive examinations on the same components.

A system comprises:

a. a transducer;

b. a single-channel instrument or each channel of a multichannel instrument; and

c. a given cable type and length.

The checks described in paragraphs 1.1 and 1.2 should be made for any UT system used for inspection of reactor pressure vessel (RPV) welds.

The field performance checks described in 1.2 (with the possible exception of 1.2.c) should be conducted on a basic calibration block that represents the thickness range to be examined.

SwRI agrees with the need to define and document the performance characteristics of UT systems, and we have been doing so for many years. Most of the checks identified herein have been standard operating practice for SwRI. SwRI applies these requirements to all reactor vessel weld examinations, whether the examinations are manual, automated from the inside surface, or automated from the outside surface. Since the results of the field performance checks described in 1.2 are independent of calibration block design, SwRI procedures allow the use of any calibration block that will provide the signal responses needed for the performance check.

1.1 Preexam Performance Checks

a. Frequency of Checks

These checks should be verified within 6 months before reactor pressure vessel examinations performed during one outage. Pulse shape and noise suppression controls should remain at the same settings during calibration and examination.

b. RF Waveform

A record of the RF (radiofrequency) pulse waveform from a reference reflector should be obtained for each search unit used in the examination in a manner which will provide frequency amplitude information. At the highest amplitude portion of the beam, the RF return signal should be recorded before it has been rectified or conditioned for display. The reflector used in generating the RF return signal as well as the electronic system (i.e., the basic ultrasonic instrument, gating, and form of gated signal) should be documented. These records should be used for comparison with previous and future records.

SwRI performs a complete laboratory analysis of every search unit in inventory at least every 12 months. This analysis includes not only recording the RF pulse waveform identified above, but also determination of the frequency spectrum and distance amplitude curve for each search unit. Search units that do not meet strict performance tolerances are discarded or labeled as not acceptable for field use. Documentation of this analysis is provided to SwRI clients prior to the job and is also included in the final examination report.

In addition to the laboratory search unit analysis, SwRI photographs the RF waveform in the field during initial and final calibrations. This provides a record of the RF waveform obtained using the specific system components (transducer, instrument, and cable) that are used for calibration and examination.

1.2 Field Performance Checks

a. Frequency of Checks

As a minimum, these checks should be verified on site before and after examining all the welds that need to be examined in a reactor pressure vessel during one outage. Pulse shape and noise suppression controls should remain at the same settings during examination and calibration.

b. Instrument Sensitivity During Linearity Checks

The initial instrument sensitivity during the performance of 1.2.e should be such that it falls at the calibration sensitivity or at some point between the calibration sensitivity and the scanning sensitivity.

c. RF Waveform

A record of the RF (radiofrequency) pulse waveform from a reference reflector should be obtained and recorded in a manner that will permit extraction of frequency amplitude information. At the highest amplitude portion of the beam, the RF return signal should be recorded before it has been rectified or conditioned for display. This should be determined on the same reflector as that used in 1.1.b above. This record should be retained for future reference.

d. Screen Height Linearity

Screen height linearity of the ultrasonic instrument should be determined according to the mandatory Appendix I to Article 4, Section V of the ASME Code or Appendix I to Section XI of the ASME Code.

e. Amplitude Control Linearity

Amplitude control linearity should be determined according to the mandatory Appendix II of Article 4, Section V, of the ASME Code or Appendix I of Section XI of the ASME Code.

f. Angle-Beam Profile Characterization

The vertical beam profile should be determined for each search unit used during the examination by a procedure similar to that outlined in nonmandatory Appendix B-60, Article 4, Section V, of the ASME Code or Appendix I to Section XI of the ASME Code. Beam profile curves should be determined at different depths to cover the thicknesses of materials to be examined. Interpolation may be used to obtain beam profile correction for assessing flaws at intermediate depths for which beam profile has not been determined.

Beam profile measurements should be made at the sensitivity required for sizing. For example, sizing to 20-percent DAC criteria requires that the beam profile be determined at 20-percent DAC.

The field performance checks described above are performed by SwRI as follows:

(1) RF Waveform - SwRI photographs the RF waveform in the field during each initial and final calibration. This provides a record of the RF waveform obtained using the specific system components (transducer, instrument, and cable) that are used for calibration and examination.

(2) Screen Height Linearity - Screen height linearity checks are performed for each instrument in accordance with the Reg Guide requirements. These checks are performed immediately before and after completion of the examinations.

(3) Amplitude Control Linearity - Amplitude control linearity checks establish a linear relationship between an adjustment of the gain, or sensitivity, controls (knobs or switches) and the corresponding signal amplitude change observed on the CRT.

In the case of manual examinations, the gain controls are used to determine the amplitude as a percentage of the Distance Amplitude Correction (DAC) curve by adjusting the controls until the signal meets the DAC curve and calculating the indication amplitude based upon the amount of gain adjustment. Since the gain controls are used to indirectly calculate indication amplitude, it is important for the relationship between control adjustments and corresponding signal changes to be linear regardless of how large or small the indication is prior to the control adjustment. In the case of manual examinations in accordance with Reg. Guide 1.150, amplitude control linearity is determined for each instrument in accordance with the Reg Guide requirements. These checks are performed in conjunction with the screen height linearity checks immediately before and after completion of the examinations.

Paragraph 1.2.b above requires that the instrument sensitivity during the performance of amplitude control linearity checks should be at the calibration sensitivity or between the calibration sensitivity and scanning sensitivity. However, the calibration sensitivity levels (and scanning sensitivity levels) vary with the different techniques used during vessel examinations. Therefore, SwRI performs these linearity checks at the extreme upper and lower ends of the sensitivity range. This ensures that the instrument is linear across a wide range of calibration and scanning sensitivity levels.

In the case of automated examinations, SwRI's Time Control Gain (TCG) circuitry electronically compensates for the normal signal attenuation that causes a sloping DAC curve and provides a variable gain adjustment across the CRT screen such *that a constant horizontal DAC curve is attained. Therefore, with TCG, indication amplitudes as a percentage of DAC are not determined by adjusting the gain controls, but instead, can be determined directly by monitoring the digitized signal voltage, or visually by using the horizontal screen grids. The performance of the TCG circuitry is ascertained at SwRI's calibration laboratory at least every 12 months and also onsite during examinations by periodically verifying that the TCG is, in fact, maintaining a straight horizontal DAC. In essence, whenever the amplitude controls are used for indication amplitude measurement, SwRI performs amplitude control linearity checks; however, in most cases the checks are unnecessary when using the TCG system.*

(4) Angle-Beam Profile Characterization - A beam profile for each single element pulse-echo angle-beam search unit is determined on site in accordance with the Reg Guide requirements. These profiles are generated using the 1/4, 1/2, and 3/4T side-drilled holes in a calibration block that is as thick or thicker than the component to which the search unit will be applied. Since Appendix A of the Reg Guide permits sizing at either 20% or 50% of DAC, SwRI takes both 20% and 50% beam profiles.

With the use of tandem dual-refracted longitudinal wave search units for near surface examination, typical sizing methodologies are not applicable because of the unique search unit performance. Therefore, when near surface indications are observed with these techniques, special supplemental sizing techniques may be required depending upon the observed characteristics of the flaw. These special supplemental sizing techniques have been substantiated and qualified using mockups, field experience, and research project data over many years.

2. <u>CALIBRATION</u>

System calibration should be performed to establish the DAC curve and the sweep range calibration in accordance with Article 4, Section V, of the ASME Code or Appendix I to Section XI. Calibration should be confirmed before and after each RPV examination, or each week in which the system is in use, whichever is less. Where possible, the same calibration block should be used for successive inservice examinations of the RPV.

System calibration is performed on site by SwRI in accordance with Reg Guide requirements on the applicable basic calibration block.

Calibration confirmation during manual examinations is performed prior to the examination; at least every four hours during the examinations; with any substitution of search unit, cable, or power source; and upon completion of the examinations.

For mechanized examinations, SwRI performs calibration confirmation prior to the start of a series of examinations (a series is considered to be similar examinations performed using the same examination techniques and the same equipment configuration); with any substitution of search unit, cable, or power source; whenever the device is removed from the examination area; at least every week during the examinations; and at the completion of a series of examinations. While this calibration confirmation frequency is consistent with the Reg. Guide, it sometimes does not comply with the 12-hour frequency requirements of Paragraph T-432.1.2 of Section V. Because of the inherent stability and reliability of the SwRI electronic equipment, however, SwRI has never experienced problems meeting calibration confirmation criteria when going beyond the 12-hour time period. The *acceptability of exceeding the Section V 12-hour calibration check can be demonstrated as allowed in Paragraph IWA-2240 of Section XI.*

2.1 Calibration for Manual Scanning

For manual sizing of flaws, static calibration may be used if sizing is performed using a static transducer. When signals are maximized during calibration, they should also be maximized during sizing. For manual scanning for the detection of flaws, reference hole detection should be shown at scanning speed and detection level set accordingly.

As required above, SwRI uses static calibration and static sizing techniques for manual examinations, maximizing both calibration and flaw signals. Reference hole detection is verified by scanning over the calibration block at the maximum scanning speed and verifying that the signal meets or exceeds the recording level.

2.2 Calibration for Mechanized Scanning

When flaw detection is to be done by mechanized equipment, the calibration should be performed using the following guidelines:

a. The DAC curve should be established using either a moving transducer mounted on the mechanism that will be used for examination of the component or a mechanism that duplicates the critical factors (e.g., transducer mounting, weight, pivot points, couplant) present in the scanning mechanism.

b. Calibration speed should be at or higher than the scanning speed, except when correction factors established in 2.2.d are used.

c. The direction of transducer movement (forward or backward) during calibration to establish the DAC curve should be the same direction during scanning unless it can be shown that a change in scanning direction does not reduce flaw detection capability.

d. One of the following alternative guidelines should be followed to establish correction factors if static calibration is used:

(1) Correction factors between dynamic and static response should be established using the basic calibration block or,

(2) Correction factors should be established using models and taking scaling factors into consideration (assumed scaling relationship should be verified) or,

(3) Correction factors should be established using full-scale mockups.

SwRI complies with these requirements for calibration for mechanized scanning in accordance with 2.2.d(1) in that we have repeatedly demonstrated equivalency between the scanning with the SwRI PaR devices or track-mounted scanners and our static calibration techniques. SwRI routinely provides a report to its customers documenting this equivalency using the equipment pertinent to each customer's application.

2.3 **Calibration Confirmation**

Calibration confirmation performed as midshift or interim confirmation between onsite calibrations should comply with stability requirements in T-433, Article 4, Section V, of the ASME Code.

When an electronic simulator is used for onsite calibration confirmation after a Code-required block calibration performed off site, the following should also apply:

a. Complete system performance should be maintained stable prior to offsite calibrations and onsite calibration confirmation by use of target reflectors. The target reflectors should be mounted with identical physical displacement in both the offsite calibration facilities and the onsite mechanized equipment. Each onsite periodic calibration should be preceded by complete system performance verification using a minimum of two (2) target reflectors separated by a distance representing 75 percent of maximum thickness to be examined.

b. Written records of calibrations should be established for both target reflector responses and Code calibration block DAC curves for each transducer. These written records may be used to monitor drift since the original recorded calibration.

c. Measures should be taken to ensure that the different variables such as temperature, vibration, and shock limits are minimized by controlling packaging, handling, and storage.

SwRI calibration confirmations are performed at the frequency specified in paragraph 2 above and are in compliance with the stability requirements of the Reg Guide. SwRI calibration confirmations are performed on site using the basic calibration block, not an electronic block simulator. As such, the additional requirements identified in this paragraph for the use of an electronic block simulator do not apply.

In addition to periodic calibration confirmations, functional checks of the UT instruments and the TCG system are typically performed at shift changeover. These checks utilize electronic signal generators to monitor for changes in sweep and amplitude displays. The stability criteria of Paragraph T-433 of Article 4 are used for acceptability of these functional checks.

For PWR full vessel examinations using SwRI's Fast PaR system, two Data Acquisition Systems are utilized in parallel. While one system is used for scanning and data acquisition, the other system is being calibrated for the next series of examinations. In effect, two separate cable systems are used, one for calibration and another for examination. SwRI's Remote Cable Calibrator system allows comparison of the difference in cable performance and also provides electronic signal generation for periodic verification that the performance of the two cable systems has not changed. These cable performance checks are performed at the same time and using the same criteria as the electronic functional checks described above.

2.4 **Calibration Blocks**

Calibration blocks should comply with Appendix I to Section XI or Article 4, Section V, of the ASME Code. When an alternative calibration block or a new conventional block is used, a ratio between the DAC curves obtained from the original block and from the new block should be noted (for reference) to provide for a meaningful comparison of previous and current data.

The calibration side-drilled holes in the basic calibration block and the block surface should be protected so that their characteristics do not change during storage. These side-drilled holes or the block surface should not be modified in any way (e.g., by polishing) between successive examinations. If the block surface or the calibration reflector holes have been polished by any chemical or mechanical means, this fact should be recorded.

SwRI procedures require the use of calibration blocks that are fabricated in accordance with the Reg Guide requirements for standard Code techniques. When special techniques are utilized, such as dual tandem beam examination of the near-surface volume or special nozzle inner radius examination, SwRI recommends modification of conventional blocks in order to accommodate the requirements of the special technique. Whenever possible, existing Code requirements are used as guidance for the SwRI recommendations.

It is SwRI's recommendation that the same calibration block be used for repetitive examinations. However, whenever calibration blocks are changed, SwRI also recommends that a correlation be performed if possible to aid in comparison of indications if necessary.

3. EXAMINATION

The scope and extent of the ultrasonic examinations should comply with IWA-2000, Section XI, of the ASME Code.

If electronic gating is used to define the examination volume within which indications are recorded, the start and stop control points should include the entire required thickness including the material near each surface.

If a single gate is used, it should be capable of recording multiple indications appearing in the gate. Alternative means of recording may be used providing they do not reduce flaw detection and recording capability.

Examination should be done with a minimum 25-percent scan overlap based on the transducer element size.

The scope and extent of manual examinations are addressed in the examination plan and examination procedures in accordance with IWA-2000.

In order to ensure that the scope and extent of automated examinations comply with IWA-2000 of Section XI, SwRI prepares a detailed Scan Plan for each automated examination activity in addition to typical examination procedures. This plan addresses device configurations, scanning parameters, calibration parameters, gate settings, and other specific information needed to perform the work. Implementation of the SwRI scan plan, as prepared for a specific application, will ensure that the full volume of the ASME examination area is examined to the extent allowed by that vessel configuration. Coverage is accomplished using a combination of several beam angles and examination techniques as specified in the scan plans.

The electronic gating system utilized by SwRI does not limit the examination volume within which indications are recorded. When the SwRI standard data acquisition system is used, a video recording is made of the actual UT instruments' CRT presentations with the search unit positional information superimposed in real time.

SwRI's "state-of-the-art" enhanced data acquisition system has overlapping electronic gating for each UT channel such that a full volume examination is digitized, recorded, and displayed. The SwRI enhanced data acquisition system gating is capable of recording multiple simultaneous indications.

All examinations performed in accordance with this Reg. Guide are performed using a 25-percent overlap, unless a greater overlap is required.

3.1 Internal Surface

The capability to effectively detect defects at the internal clad/-base metal interface shall be considered acceptable if the examination procedure(s) or technique(s) meet the requirements of Section 6.0 of this document and demonstrate the following:

a. Procedures for examination from the outer surface, or when using full vee from the inside surface, should include the use of the 2-percent notch which penetrates the internal (clad) surface of the calibration blocks, defined by Section XI, Appendix I, Figure I-3131, or Section V, Article 4, Figure T-434-1. Procedures for examination from the internal surface when not using the full vee should conform to paragraph 3.1.b below.

b. An alternate reflector, other than the 2-percent notch described above, may be used provided: (1) that it is located at the clad/ base metal interface or at an equivalent distance from the surface, (2) that it does not exceed the maximum allowable defect size, and (3) that equivalent or superior results can be demonstrated.

c. The examination procedure(s) should provide for volumetric examination of at least 1 inch of metal as measured perpendicular to the nominal location of the base metal cladding interface.

SwRI procedures for examination from the outside surface of the vessel wall use the 2-percent notch for reference as specified in Paragraph 3.1(a). These procedures also include a half vee calibration with the notch used for evaluation of all indications which appear at the inside surface of the examination area.

SwRI procedures for tandem beam examination from the inside surface utilize 1/8-inch diameter side-drilled holes at the clad/base metal interface as described in Paragraph 3.1(b). In both cases, SwRI procedures provide for volumetric examination of greater than 1-inch depth below the cladding interface as required by Paragraph 3.1(c). SwRI has demonstrated that the reference sensitivity established on the 1/16-inch diameter side-drilled holes meets or exceeds that specified in Section XI of the ASME Code. This technique has also been demonstrated to have the capability of detecting flaws with good signal-to-noise discrimination at depths of at least 2-3/4 inches below the clad-to-base metal interface, thus overlapping the through-wall zone of calibrated sensitivity of the 45-degree and 60-degree beams. Using the tandem beam transducers, SwRI has detected *flaws of minute size in the area between the clad-to-base metal interface and the first 45-degree and 60-degree DAC point.*

SwRI has also used 70-degree dual (side-by-side mounted piezoelectric elements) search units for underclad examinations; however, the useful range is limited to approximately 1-inch of depth below the cladding with no discernible improvement over the tandem beam search unit at the clad-to-base metal interface.

3.2 Scanning Weld-Metal Interface

The beam angles used to scan welds should be based on the geometry of the weld/parent metal interface. Where feasible for welds such as those identified in Section T-441.4.2 of Article 4, Section V, of the ASME Code, at least one angle should be such that the beam is perpendicular (±15 degrees to the perpendicular) to the weld/parent metal interface, or it should be demonstrated that unfavorably oriented planar flaws can be detected by the UT technique being used. If this is not feasible, use of alternative volumetric NDE techniques, as permitted by the ASME Code, should be considered.

For RPV shell seam welds, SwRI uses the nominal Code-specified 0-degree, 45-degree, and 60-degree, beams to examine the full volume of the wall section except for the volume of material near the beam entry point, for which we use the previously mentioned tandem search units.

Section T-441.4.2 (or T-441.3.2.2 of the 1986 Edition) of Article 4, Section V, states that beam angles other than 0-degree, 45-degrees, and 60-degrees should be used for the examination of (a) flange welds when the examination is conducted from the flange face, (b) nozzles and nozzle welds when the examination is conducted from the nozzle bore, (c) attachment and support welds, and (d) examination of double taper junctions. SwRI has employed this approach for many years.

SwRI procedures, however, often provide more than Code-specified coverage where feasible. Each of the unique weld configurations noted above is evaluated to determine the best and most comprehensive coverage attainable. Where necessary, other angle and straight beam examinations are performed to assure complete coverage of nozzle-to-shell, vessel-to-flange, and attachment welds. Previously mentioned tandem beam techniques are also utilized to provide the required near surface coverage when nozzle bore examinations are performed.

4. BEAM PROFILE

Delete entire paragraph. This section included in Recommended Change 1.2.f, Angle Beam Profile Characterization.

5. SCANNING WELD-METAL INTERFACE

Delete entire paragraph. This section included in Recommended Change 3.2, Scanning Weld-Metal Interface.

6.0 **RECORDING AND SIZING**

The capability to detect, record, and size the flaws delineated by Section XI, IWB-3500, should be demonstrated. The measurement tolerance established should be applied when sizing flaws detected and recorded during scanning (see paragraph 7.a).

The requirement to demonstrate the capability to detect, record, and size flaws can be interpreted many ways. A liberal interpretation might be that years of industry experience has demonstrated that Code techniques are capable of detecting, recording, and sizing flaws. A conservative interpretation might be that a mockup of every conceivable weld configuration should be fabricated containing implanted flaws and examined in order to demonstrate and document the capability. SwRI feels that the real need is somewhere in between.

We have considerable experience and documentation to show that the 45-degree and 60-degree Code examinations and those using the tandem probes are effective for detecting and recording flaws in seam welds when scanning from either the inside or outside surface of the vessel. Our experience also shows that beam angles that are designed to be essentially normal to the weld are effective in detecting and recording flaws in the nozzle-to-shell welds from the nozzle bore. By virtue of actual flaw detection using current techniques, SwRI's UT procedures are well qualified.

Although the capabilities of SwRI procedures to detect and record flaws has been demonstrated on a significant variety of test specimens and in reactor vessels during actual inservice and preservice examinations, it cannot be practically demonstrated that the techniques and equipment have the capability to size flaws with any predictable tolerance. Many research studies throughout the history of the nuclear industry have attempted to quantify the sizing ability of various NDE applications, none have established universally accepted results. The different joint configurations, plate thicknesses, flaw locations within the weld, flaw orientations, and acoustic characteristics of the component material all contribute to the inherent variability of sizing techniques.

As always, SwRI will continue to recommend to our customers the thorough evaluation of any flaws that are detected and recorded during our examinations. These recommendations have included, and will continue to include, Code and non-Code sizing techniques, the use of supplemental NDE techniques if practical, construction of mockups of the particular configuration in question, research of data from similar examinations and studies, and calling in consultants with particular expertise in the type of problem (from outside SwRI if appropriate) to fully evaluate the examination and the results. We will also assist our clients in every way possible with NRC evaluations of reportable indications and in the use of Fracture Mechanics techniques.

6.1 Geometric Indications

Indications determined to be from geometric sources need not be sized. Recording of these indications should be at 50-percent DAC. When indications are evaluated as geometric in origin, the basis for that determination should be described. After recording sufficient information to identify the origin of the geometric indication, further recording and evaluation are not required.

Indication analysis and sizing are performed as an independent onsite activity by SwRI. All of the examination data is reviewed by Level II or Level III examiners to the extent necessary to determine the origin of any recorded indications.

Indications that are geometric in origin are recorded at 50-percent DAC and the nature of each such indication is documented.

6.2 **Indications with Changing Metal Path**

a. Indications that change metal path distances (indicating through-wall dimension), when scanned in accordance with the requirements of ASME Section XI for a distance greater than that recorded from the calibration reflector, should be recorded.

b. Reflectors which are at metal paths representing 25 percent and greater of the through-wall thickness of the vessel wall measured from the inner surface should be recorded in accordance with the requirements of ASME Section XI and characterized at 50-percent DAC.

c. Reflectors which are within the inner 25 percent of the through-wall thickness should be recorded at 20-percent DAC. Characterization should be in accordance with the demonstrated methods under paragraph 6.0. When the indication is sized at 20-percent DAC, this size may be corrected by subtracting the beam width in the through-thickness direction obtained from the calibration hole (between 20-percent DAC points) which is at a depth similar to the flaw depth. If the indication exceeds 50-percent DAC, the length should be recorded by measuring the distance between 50-percent DAC levels. The determined size should be the larger of the two.

SwRI believes that the intent of this paragraph is to require that the examiner attempt to determine and document the most accurate size of a reflector having through-wall dimension. To the extent practicable, SwRI data analysis of traveling indications is performed in accordance with these requirements.

SwRI typically performs both 20-percent and 50-percent beam spread measurement at the time of calibration in case the information is needed during data analysis. However, sizing with beam spread correction at 20-percent DAC should not be generally applied without caution as this approach produces widely varied sizing data, including negative flaw sizes in certain cases.

For tandem beam search units, the use of beam spread correction for sizing is not normally applicable because of the unique beam profile characteristics. When near surface indications are observed during a vessel examination that are evaluated to be flaws, SwRI routinely applies one or more sizing techniques in order to obtain the best estimate of the flaw size before comparing the size to the acceptance criteria of Section XI.

In general, SwRI concurs with the specified approach, but also recommends application of selected alternate sizing techniques when necessary based upon a case-by-case evaluation to determine which technique is considered most appropriate for the anticipated flaw type and orientation.

6.3 Indications Without Changing Metal Path

a. Indications which do not change metal path distance when scanned in accordance with the requirements of ASME Section XI and are within the outer 75 percent of the through-wall dimension should be recorded when any continuous dimension exceeds 1 inch.

b. If the indication falls within the inner 25 percent of the through-wall dimensions, it should be recorded at 20-percent DAC and evaluated at 50-percent DAC.

c. Precautionary note: Indications lying parallel to welds may appear as nontraveling (without changing metal path) when scanned by parallel moving transducers whose beams are aimed normal to the weld, i.e., at 90 degrees. Multiple scans, however, may reveal that these indications are traveling indications. If so, recording and sizing are to be done in accordance with paragraph 6.2.

To the extent practicable, SwRI data analysis of nontraveling indications is performed in accordance with these requirements, along with the use of additional sizing techniques where appropriate.

The precautionary note of Paragraph 6.3.c is appropriate. To alleviate this concern, SwRI performs scanning in the direction of the beam component wherever possible. In those instances when this preferred mode of scanning cannot be utilized, SwRI procedures address this concern by requiring additional scans (along with sound beam direction) of any nongeometric angle-beam indication observed during scans made parallel to the weld. These additional scans are performed using small scan increments (or large transducer overlap) in order to develop a very accurate data set. This data set allows a determination of whether the indication is a traveling or nontraveling indication and also provides accurate data for sizing purposes if necessary.

6.4 Additional Recording Criteria

The following information should also be recorded for indications that are reportable according to this regulatory position:

a. Indications should be recorded at scan intervals no greater than 1/4 inch.

b. The recorded information should include the indication travel (metal path distance) and the transducer position for 20-percent (where applicable), 50-percent, and 100-percent DAC and the maximum amplitude of the signal.

c. When multichannel equipment is used in the examination system such that all examination displays are not available for simultaneous viewing, an electronic gating system should be used which will provide on-line, reproducible, recorded information regarding metal path, amplitude, and position of all indications exceeding a preset level. The preset level should be the minimum recording level required. To ensure that all recordable indications are recorded, a preferred method would incorporate multigates in each channel or a single gate for each channel with multi-indication recording capability.

In reference to Paragraph 6.4.a, SwRI typically performs initial scanning using a 25% overlap as specified in Paragraph 3. However, data to be utilized for specific sizing or investigation of indications that exceed the allowable limits of Section XI is acquired at 1/4-inch, or less, scan intervals.

The information required in Paragraph 6.4.b is typically recorded by SwRI for all vessel examinations, whether the examination is performed manually or using automated equipment.

In reference to Paragraph 6.4.c which addresses the use of multi-channel equipment, the SwRI standard data acquisition system satisfies this requirement by virtue of the video recording of the instrument screens. Since the entire screen presentation is recorded, simultaneous multiple signals are recorded if encountered. The data analysis process also includes review of all of the video tape data thereby ensuring that each recorded signal is reviewed and analyzed.

SwRI's "state-of-the-art" enhanced data acquisition system has the capability to individually record simultaneous multiple indications by digitizing and storing the entire waveform, thus significantly streamlining and accelerating the data acquisition and analysis process.

7. REPORTING OF RESULTS

Records obtained while following the recommendations of regulatory positions 1,2, 3, and 6, along with discussions and explanations, if any, should be kept available at the site. If the size of an indication, as determined in regulatory positions 6.2 or 6.3, exceeds the allowable limits of Section XI of the ASME Code, the indications should be reported as abnormal degradation of reactor pressure boundary in accordance with the recommendation of regulatory position 2.a(3) of Reg. Guide 1.16.

Along with the report of ultrasonic examination test results, the following information should also be included:

a. The best estimate of the tolerances in sizing the flaws at the sensitivity required in Section 6 and the basis for this estimate.

This estimate may be determined in part by the use of additional reflectors in the basic calibration block.

b. A description of the technique used to qualify the effectiveness of the examination procedure, including, as a minimum, material, section thickness, and reflectors.

c. The best estimates of the portion of the volume required to be examined by the ASME Code that has not been effectively examined such as volumes of material near each surface because of near-field or other effects, volumes near interfaces between cladding and parent metal, volumes shadowed by laminar material defects, volumes shadowed by part geometry, volumes inaccessible to the transducer, volumes affected by electronic gating, and volumes near the surface opposite the transducer.*

*It should be noted that the licensee is required to apply for relief from impractical ASME Code requirements according to 50.55a of 10CFR. If the licensee is committed to examine a weld as per the inspection plan in the plant SAR, the licensee is required to file an amendment when the commitments made in the SAR cannot be met.

Sketches and/or descriptions of the tools, fixtures, and component geometry which contribute to incomplete coverage should be included.

d. Provide sketches of equipment (i.e., scanning mechanism and transducer holders) with reference points and necessary dimensions to allow a reviewer to follow the equipment's indication location scheme.

e. When other volumetric techniques are used, a description of the techniques used should be included in the report.

In reference to Paragraph 7.a, SwRI feels that the sizes obtained using Code sizing techniques should be used consistently for comparison to Code acceptance standards whenever possible. Based on SwRI experience, Code sizing techniques appear to be somewhat conservative; however, there is little evidence to support the feasibility of developing specific tolerances or correction factors for Code sizing techniques. Nor is there significant evidence of improved accuracy and consistency resulting from the use of any one alternate sizing technique. Alternate sizing methods must be used carefully and, in effect, should be used only when it can be determined that the Code sizing techniques are, for some reason, inappropriate for the specific type of flaw encountered.

These statements do point out that flaw sizes based on UT are estimates. We, of course, have varying degrees of confidence in flaw size estimates depending on pertinent examination variables. Since the ramifications of our flaw size estimations are very great, SwRI will typically recommend certain actions to our customer which can increase our confidence in flaw size estimation. These recommendations may include actions such as:

(a) placing additional holes in the calibration block

(b) constructing mockups of the examination area

(c) using other NDE equipment

(d) applying alternate NDE methods

(e) performing certain laboratory tests

(f) calling in specialists with particular experience in similar problems.

In reference to Paragraph 7.b, the basis for all SwRI procedure qualifications is documented and available for audit by client or regulatory personnel at any time.

In reference to Paragraph 7.c, SwRI provides a detailed limitations report for all reactor vessel examinations. The limitations report is a combination of tables and sketches that depict and quantify the various limitations to the Code-required coverage. These reports compile all of the various pertinent data into a concise, understandable format and can be used as the basis for Relief Requests if necessary.

The information identified in Paragraph 7.d is routinely provided in the SwRI Scan Plan prior to performance of examinations. In addition, a copy of the "as executed" Scan Plan is reproduced and included in the SwRI Final Report.

In reference to Paragraph 7.e, when alternate techniques are utilized, either for examination or sizing purposes, a complete description of the application and results is included in the SwRI Final Report.