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SUBJECT: Forwards revised ISI program Relief Requests 2-ISI-001 & 2-ISI-010 to be implemented during third insp period of first insp interval.GE coverage repts for R-8 & R-7 & coverage plot for N3 - main steam also encl.

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MA2

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352-0968 • (509) 372-5000

June 24, 1993
G02-93-166

Docket No. 50-397

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: **WNP-2, OPERATING LICENSE NPF-21**
INSERVICE INSPECTION PROGRAM
RELIEF REQUESTS 2-ISI-001 AND 2-ISI-010

References:
1) Letter G02-86-679, dated July 22, 1986, G.C. Sorensen (SS) to Ms. E.G. Adensam (NRC), "Inservice Inspections and Inservice Testing Programs and Response to Request for Information"
2) Letter, dated March 27, 1987, Ms. E.G. Adensam (NRC) to G.C. Sorensen (SS), "Safety Evaluation for First Ten-Year Interval Inspection Program and Requests for Relief from Certain Requirements"
3) 10CFR50.55a, August 6, 1992.

This letter submits for Commission review and approval, revised relief request 2-ISI-001 and new relief request 2-ISI-010. Both relief requests will be implemented during the third inspection period of the first inspection interval.

Relief request 2-ISI-001 was submitted to the Commission by Reference 1 and approved by Reference 2. On August 6, 1992, the Commission issued 10CFR50.55a (Reference 3) which revoked all previously granted relief requests for Reactor Pressure Vessel (RPV) shell welds (Section XI category B-A, item number B1.10). At refueling outage R-8 (Spring 1993) WNP-2 performed RPV weld examinations and was able to comply with the increased coverage required in Reference 3 except for one longitudinal weld. Revised relief request 2-ISI-001 defines the coverage obtainable.

Relief request 2-ISI-010 defines the examination coverage obtainable on the RPV nozzle-to-vessel welds. Complete Code required volume was not obtainable due to the nozzle configuration.

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1/1

020049

Commission review and disposition is requested prior to February 1, 1994, to support the Spring 1994 refueling outage.

Sincerely,

J. V. Parrish (Mail Drop 1023)
Assistant Managing Director, Operations

MGE/bk

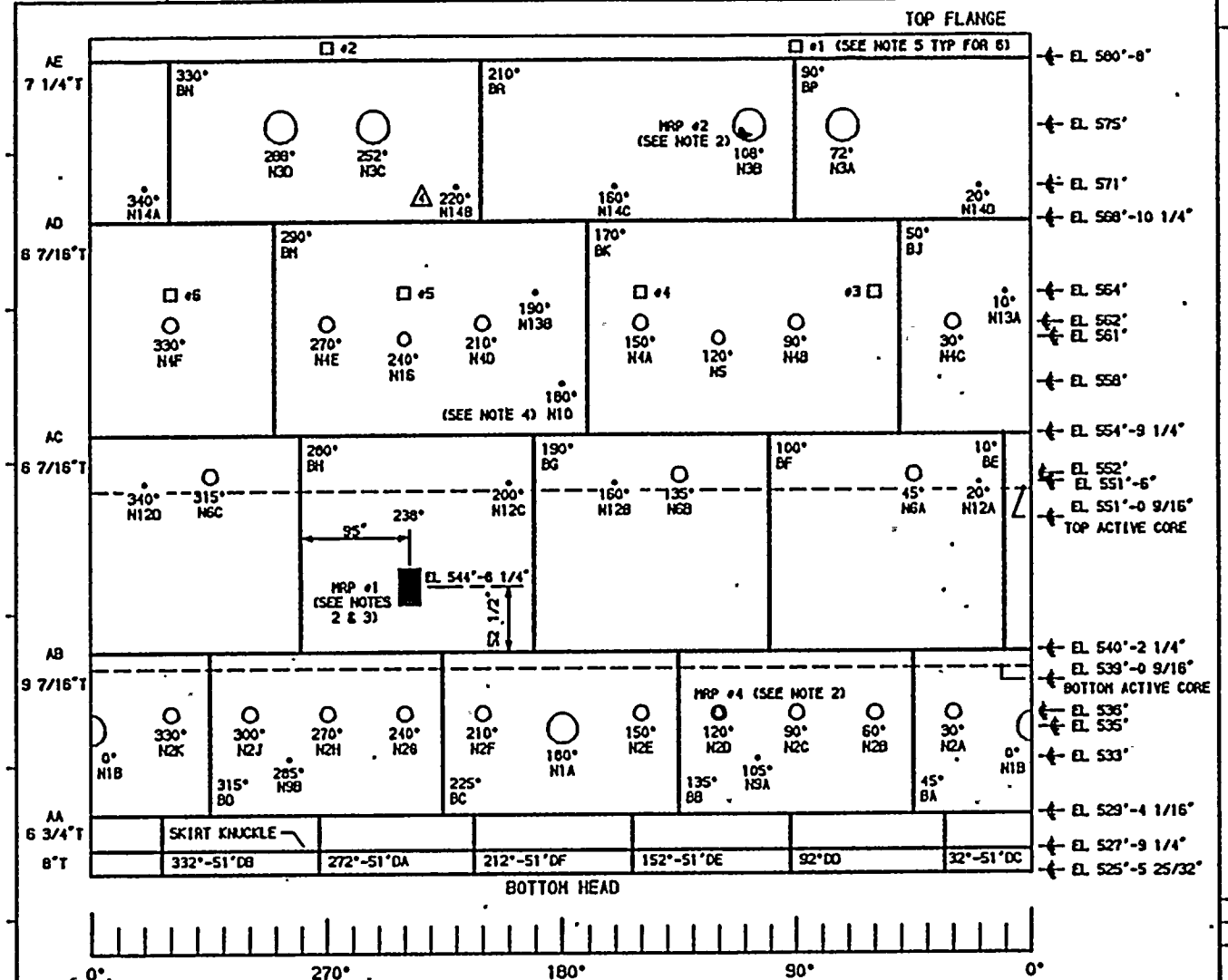
Attachments: 1) ISI Weld and Component Diagram RPV-101, RPV-102

2) Relief Request 2-ISI-001
General Electric Coverage Report for R-8

3) Relief Request 2-ISI-010
General Electric Coverage Report for R-7
Coverage Plot for N3 - Main Steam

cc: BH Faulkenberry - NRC RV
NS Reynolds - Winston & Strawn
JW Clifford - NRC
DL Williams - BPA/399
NRC Site Inspector - 901A

ATTACHMENT 1



OUTSIDE VIEW

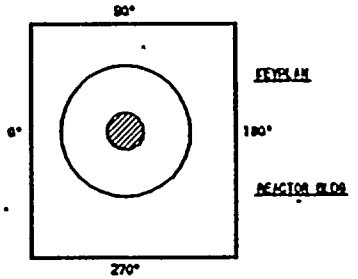
THIS DRAWING IS INTENDED FOR USE IN PRESERVICE AND INSERVICE INSPECTIONS PROGRAMS ONLY.

NOTES:

1. REFER TO PROGRAM PLAN & SCHEDULE TABLES FOR EXAMINATION & CALIBRATION BLOCK REQUIREMENTS.
2. "MRP" INDICATES MAJOR REPAIR AREA. MRP #3 AT N2E NOZZLE TO SAFE-END WELD PREP IS NOT SHOWN.
3. MRP #1 IS 2 3/4" TO 3 7/8" IN DEPTH & IS 15" WIDE BY 30" HIGH. NOTE THAT MRP #1 AREA CENTER IS DIMENSIONALLY REFERENCED.
4. FOR DETAILS OF NOZZLE ASSEMBLY SEE RPV-113.
5. CLADDING PATCH LOCATIONS:
   - #1 AT 90° AZ
   - #2 AT 270° AZ
     (ARE 21° BELOW FLANGE LIP)
   - #3 AT 60° AZ
   - #4 AT 150° AZ
   - #5 AT 240° AZ
   - #6 AT 330° AZ
     (ARE 24" ABOVE THE N4 NOZZLES)

REFERENCES:

BURNS & ROE DRAWING M688 REV 2



4	12-9-92	CORRECTED N14B LOCATION GRAPHICALLY ADDED KEYWAY, MODIFIED LOOO, INTERNAL	K-McA	DPR	DRW	PIPING SYSTEM	NOM DIA (IN)	SCH	NOMINAL WALL THICKNESS	MATERIAL SPECIFICATION	MATL TYPE	CAL BLOCK NO
3	12-2-81	EL 551'-6" WAS 551' LOWERED ACTIVE CORE TO COINCIDE.	K-McA	DPR	TFH							
2	11-5-80	ADDED ELEVATIONS - ACTIVE CORE	K-McA	TFH	DMP	REACTOR PRESSURE VESSEL	251	NA	7 1/4, 6 7/16, 9 7/16	SA 106 GR B	CS	NOTE 1
1	7-17-79	REVISED NOZZLE LETTERS PER AS BUILT. ADDED NOTES 4 & 5.	K-McA	TFH/DMP	LFB							
0	12-22-78	ISSUED FOR USE	K-McA	TFH/DMP	LFB							
A	5-17-78	ISSUED FOR INFORMATION ONLY	K-McA	DMP	DMP							
NO	DATE	REVISION	BY	CHKD	APVD							

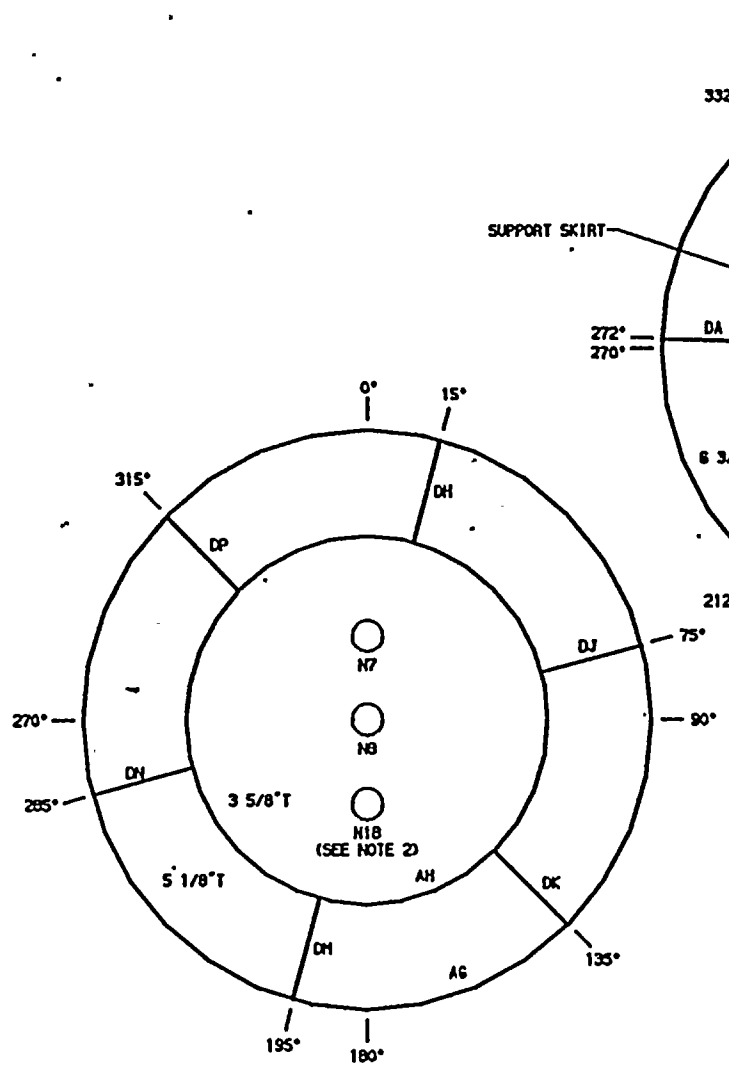
QUALITY CLASS: 1	ASME CODE CLASS: 1
ENGR: K HANNAH	DRAWN: K-McA
DATE: 2-23-78	

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
RICHLAND, WASHINGTON 99352

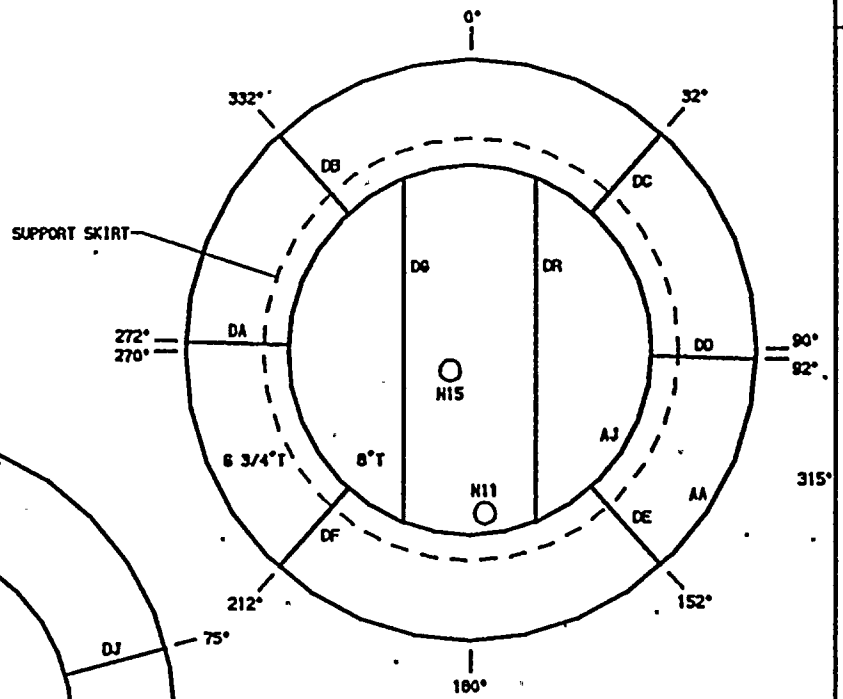
WNP-2
WELD & COMPONENT IDENTIFICATION DIAGRAM

TITLE:
REACTOR PRESSURE VESSEL ROLL-OUT

DWG NO. RPV-101 REV 4



TOP HEAD ASSEMBLY (RPV)
PLAN VIEW



BOTTOM HEAD ASSEMBLY (RPV)
INSIDE PLAN VIEW

NOTES

1. REFER TO PROGRAM PLAN & SCHEDULE TABLES FOR EXAMINATION CALIBRATION BLOCK REQUIREMENTS.
2. FOR DETAILS OF NOZZLE ASSEMBLY SEE RPV-111.

THIS DRAWING IS INTENDED FOR USE IN PRESERVICE AND INSERVICE INSPECTIONS PROGRAMS ONLY.

PIPING SYSTEM	NOM DIA (IN)	SCH	NOM WALL THK	MATERIAL SPECIFICATION	MATL TYPE	CAL BLOCK NO
TOP HEAD	251	NA	3 5/8, 5 1/8	SA 508 GR 8	CS	NOTE 1
BOTTOM HEAD	251	NA	8 3/4, 8	SA 508 GR 8	CS	NOTE 1

NO	DATE	REVISION	BY	CHKD	APVD
3	12-8-82	MODIFIED LOGO. REDRAWN	K-McA	DPR	DRW
2	12-2-81	INDICATED VESSEL SKIRT (DASHED)	K-McA	DPR	TFH
1	8-30-79	ADDED NOTE 2.	K-McA	TFH / DMP	LFB
0	12-22-78	ISSUED FOR USE	K-McA	TFH / DMP	LFB
A	5-17-78	ISSUED FOR INFORMATION ONLY	K-McA	DMP	DMP

QUALITY CLASS:	ASME CODE CLASS:	
ENGR: G AKRE	DRAWN: K-McA	DATE: 2-20-78

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
RICHLAND, WASHINGTON 99352

WNP-2
WELD & COMPONENT IDENTIFICATION DIAGRAM

TITLE:
REACTOR PRESSURE VESSEL
TOP & BOTTOM HEAD WELDS

DWG NO: RPV-102 REV 3

ATTACHMENT 2

REQUEST FOR RELIEF NO. ISI-2-001

Component or System	ASME Class 1, Section XI Category B-A pressure retaining welds in reactor pressure vessel. ~~List attached~~. *See table below*
Code	All of the subject welds were designed and fabricated to ASME Section III Class 1 1971 Edition, Summer 1971 Addenda. The inservice inspection is to be performed to the 1980 Edition Winter 1980 Addenda of ASME Section XI.
Number of Welds	Category B-A: No. ~~16~~ *9*
Section XI Requirements	Section XI requires examination of 100% of the pressure retaining welds in Category B-A be performed completely. The following examinations are required: B-A All pressure retaining welds in reactor vessel. Volumetric
Basis for Requesting Relief	Relief is required from ASME Section XI examination requirements on the basis of partial inaccessibility of the weld due to plant design. The design and access provisions complied with earlier Codes which did not require 100% examination. Per 10CFR50.55a (g) (4), access is not required to be upgraded to the Inservice Inspection Code.
Alternative Examinations	The accessible portion of each weld will be examined per Section XI requirements *augmented by Regulatory Guide 1.150, Revision 1, Appendix A.*
Impact on Plant Quality and Safety	There will be no adverse impact on plant quality and safety by doing only a partial Code examination of these welds.

1. The Class 1 RPV welds have passed radiographic, magnetic particle and ultrasonic examinations in accordance with Section III.
2. All of the identified welds will be subject to a system pressure test in accordance with Section XI Class 1 requirements.
3. Leak detection systems identify significant leakage in the areas of the subject welds. Appropriate operator action would occur due to leak detection system alarms.
4. Other similar welds in the vessel will receive full Code examinations. The integrity of the pressure boundary can thus be verified by sampling.
5. *Improves on plant quality and safety by increasing the coverage of RPV weld examinations over previous Relief Request revision.*

REQUEST FOR RELIEF NO. ISI-2-001

Category B-A

ISO No.	Weld Number	Description	% of Weld Examinable	Remarks
RPV-101	AB	#1-#2 SC CRC WD	~~52%~~ *79.7%*	See Note ~~1~~ *4*
RPV-102	DA	BTM HD MRD at 272°	~~67%~~ *78.6%*	Thermocouples at weld AA intersection. See Note 2
RPV-102	DB	BTM HD MRD at 332°	~~67%~~ *78.6%*	See Note 2
RPV-102	DC	BTM HD MRD at 32°	~~67%~~ *78.6%*	See Note 2
RPV-102	DD	BTM HD MRD at 92°	~~67%~~ *78.6%*	See Note 2
RPV-102	DE	BTM HD MRD at 152°	~~67%~~ *78.6%*	See Note 2
RPV-102	DF	BTM HD MRD at 212°	~~67%~~ *78.6%*	See Note 2
RPV-102	DG	BOT HD DOL at 270°	17%	See Note 3
RPV-102	DR	BOT HD DOL at 90°	17%	See Note 3

Notes *to Table*

1. Design of RPV shield wall and external inservice inspection system was completed prior to promulgation of amendments to 10CFR50.55a. Their design limits access to less than 100% of this weld.

2. Only 21" starting from the intersection of weld AA and 14" starting from the intersection of weld AJ can be examined due to the vessel skirt. (Approximately one foot is not being examined on each weld.)

3. Only 12" to 23" on each end of the weld, starting from the intersection of weld AJ, can be examined due to CRD penetrations and housings.

4. Examination coverage limited by weld taper.

Documentation Supporting Relief Request 2-ISI-001

On August 6, 1992, the Commission issued 10CFR50.55a with augmented RPV examination requirements. This rule revoked all previously granted relief requests for RPV shell welds in Category B-A, Item No. B1.10. This rule revoked Supply System relief ISI-2-001 for welds AA, AB, AC, AD, AE, BJ and BK. This rule also allowed utilities that could examine greater than 90% of the weld to take credit for the entire volume without seeking relief. At refueling outage, R-8, WNP-2 was able to examine greater than 90% of welds AA, AC BJ and BK. Welds AD and AE will be examined manually at R-9 and greater than 90% coverage is expected. This leaves only shell weld AB where it is not possible to obtain at least 90% examination cover.

Weld AB received 79.7% examination volume coverage at R-8. This examination was restricted due to the weld taper going from the 9 7/16" shell course 1 plate to the 6 2/16" shell course 2 plate. This weld is located about one foot above the bottom of the active core. This coverage exceeded the 52% that was obtained using the original inspection system.

WNP-2 is able to examine 92% of the total shell welds volume and 89.4% of the total shell welds volume in the belt line region. The main restriction to 100% examination in the belt line region is the taper on weld AB.

Following is the coverage report prepared for WNP-2 by General Electric at the conclusion of the R-8 RPV examinations. This report is provided to support the commission review of this relief request. Included in the report is a table listing the coverage obtained during refueling outage R-8 and coverage plates for weld AB. From these plates it can be seen that the inner portion of the examination volume is examined.

In the reports table welds BN, BP and BR are identified as receiving approximately 60% coverage due to insulation. This insulation will be removed at R-9 in support of welds AD and AE examination. The remaining volume of welds BN, BP and BR will be examined at that time. It is expected that greater than 90% coverage will be achieved.

RPV fabrication code was corrected to 1971 Edition, Summer 1971 Addendum.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
WASHINGTON NUCLEAR PLANT - UNIT 2

COVERAGE REPORT

WASHINGTON NUCLEAR PLANT UNIT 2 RFO-8 INSERVICE EXAMINATION

COVERAGE REPORT

INTRODUCTION

No automated inspection system in use today is capable of effectively examining 100% of the ASME Code examination volume defined in Section XI - IWB 2500-7(b). This fact has been recognized in that the NRC Regulatory Guide 1.150 requires that volumes that are not examined be defined and documented in the examination report.

This document describes the capability of General Electric's automated RPV inspection system (GERIS) to meet the requirements of Regulatory Guide 1.150 paragraphs 7.b and 7.c and 10CFR50-55a(g).

Examination techniques described in this report are those used by General Electric when performing automatic ultrasonic inspections on ASME Code category B-A pressure retaining welds in pressure vessels and adjoining base material regions. Scanning coverage for both longitudinal and circumferential seams is documented in this report. The ASME Boiler and Pressure Vessel Code referenced in this report is the 1980 Edition with Winter 1980 Addenda.

ASME CODE AND REGULATORY GUIDE 1.150 REQUIREMENTS

Section 50.55a, "Codes and Standards," of 10 CFR Part 50 requires that Class I components per American Society for Mechanical Engineers Boiler and Pressure Vessel Code (ASME B&PV Code) meet the requirements set forth in Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the ASME Code.

Section XI IWB-2500-1 requires that pressure retaining welds in pressure vessels be examined periodically by volumetric inspection techniques.

Ultrasonic examinations are performed in accordance with the ASME Code, Section V, Article 4 "Ultrasonic Examination When Dimensioning of Indications is Required" . Scanning is performed by angle beam and straight beam techniques per paragraphs T-441.5 through T-441.7 wherever such scanning is feasible.

The United States Nuclear Regulatory Commission (NRC) has issued Regulatory Guide 1.150, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations", to assure improved pressure vessel inspections. The recommendations of this guide are supplemental to the requirements of Section XI.

For longitudinal and circumferential seam welds in the vessel shell, and for meridianal and circumferential welds in the vessel heads, the area to be examined per Figure IWB-2500-7(b) is defined as the weld metal and 1/2T of base metal on either side of the weld.

For volumes that are inaccessible to the transducer, or volumes shadowed by part geometry that cannot be effectively examined, Regulatory Guide 1.150 paragraph 7.b requires that a best estimate of the affected volume be reported along with the ultrasonic examination results.

EQUIPMENT DESCRIPTION

The scanner used for vessel welds is shown in Fig. 1. It is held on the vessel surface by permanent magnetic wheels. No tracks are required. DC gearmotors are used for propulsion. The front wheels of the vehicle are steerable.

Attitude or heading of the vehicle is read by a pendulum attached to an encoder. A magnetic odometer wheel runs on the vessel surface to drive another encoder which reads distance travelled. A video camera and lights are mounted on the vehicle to permit the operator to see where he is going.

The scanning mechanism comprises the transducer package, shown in Fig.2, a ballscrew to move the package, stepper motors, an encoder and various support members. Couplant is supplied to the package via flexible tubing.

The transducer package includes five UT transducers: one L-wave, one 45° T-scan (transverse to the weld), one 60° T-scan, one 45° P-scan (parallel to weld) and one 60° P-scan.

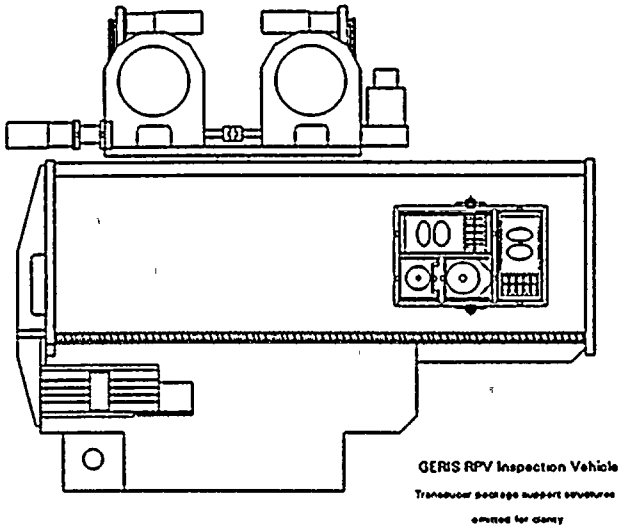


FIGURE 1

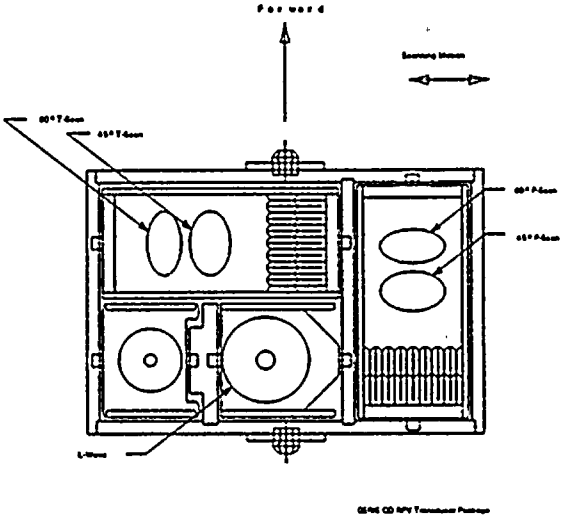


FIGURE 2

EXAMINATION TECHNIQUES

The scanner moves the transducer package across the weld as the vehicle steps along the centerline of the weld under computer control. Each transducer is pulsed as required to examine the weld. In general two passes along the weld are made, one in each direction. If required because of access limitations, it is possible to reverse the transducer package or to reverse the P-scan transducers to gain additional coverage.

SCAN LIMITATIONS AND VOLUME OF COVERAGE

Scanning of the RPV welds was restricted in several areas so that complete coverage could not be attained.

Welds where scanning was limited by the vessel design include weld AB, where the large difference in thickness between adjacent shell courses caused some areas to be missed, and sections of the bottom head meridianal welds which are covered by the support skirt. The stabilizer support brackets also constitute a limitation on scanning of some welds.

Automated scanning was limited in some areas by permanent tracks used by other examination systems and by insulation. Some of these restrictions will be removed in future outages.

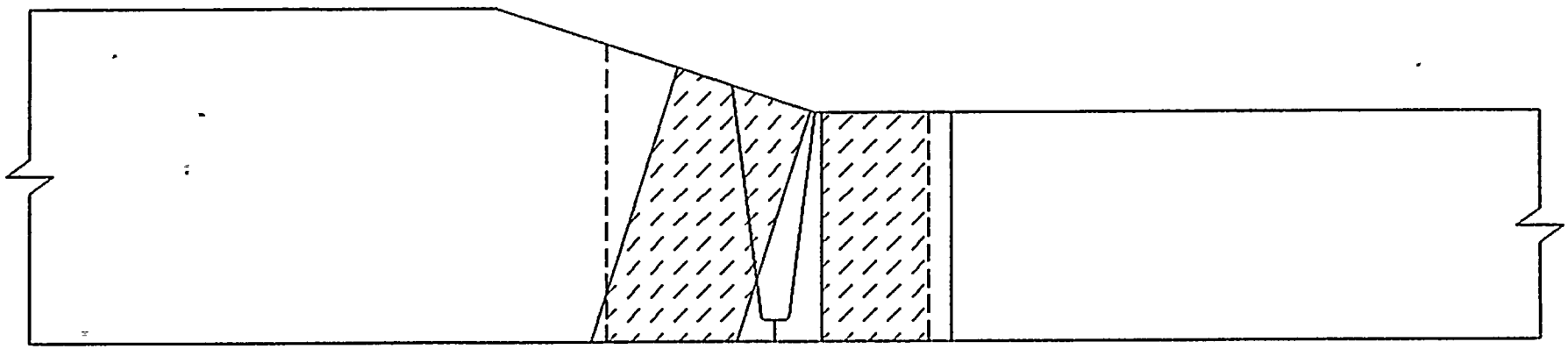
In areas where automated examination cannot be performed, manual examinations are performed to the extent feasible. Feasibility depends primarily on weld geometry and accessibility, although ALARA considerations may also apply.

Table 1 summarizes the examined volume for each weld scanned during RFO-8.

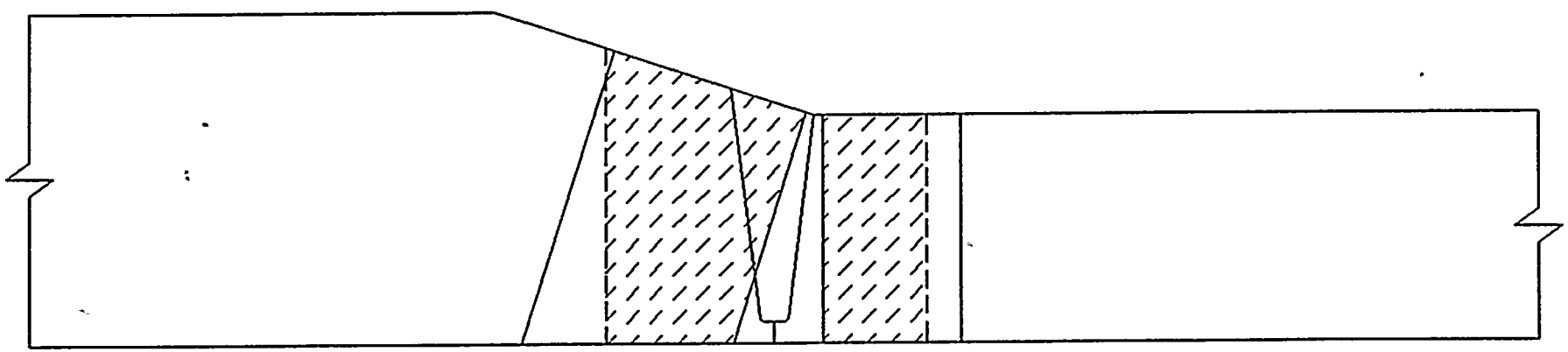
Weld ID	Length	C/S Area	Coverage	Restrictions
AA	860.2	71.8 in²	99.8%	None
AB	840.1	70.5 in²	79.7%	Taper on shell course #1
AC	840.1	57.9 in²	92.4%	nozzles N6A, N6B & N6C
AJ	684.5	70.4 in²	100%	None
BA	130.2	119.8 in²	90.8%	Taper on shell course #1, nozzles N2A & N2B
BB	130.2	119.8 in²	91.9%	Taper on shell course #1, nozzles N2D & N2E
BC	130.2	119.8 in²	91.2%	Taper on shell course #1, nozzles N2F & N2G
BD	130.2	119.8 in²	92.8%	Taper on shell course #1, nozzles N2J & N2K
BE	175.0	53.2 in²	98.1%	Taper on shell course #1, nozzle N12A
BF	175.0	53.2 in²	95.6%	Taper on shell course #1
BG	175.0	53.2 in²	98.1%	Taper on shell course #1, nozzle N12C
BH	175.0	53.2 in²	93.7%	Taper on shell course #1
BJ	169.0	61.9 in²	91.7%	Insulation, stabilizer bracket
BK	169.0	61.9 in²	96.8%	Insulation, stabilizer bracket
BM	169.0	61.9 in²	92.1%	Insulation
BN	145.9	66.8 in²	64.8%	Insulation
BP	145.9	66.8 in²	62.9%	Insulation, nozzles N3A & N3B
BR	145.9	66.8 in²	60.3%	Insulation
DA	55.8	62.7 in²	78.6%	Support skirt
DB	55.8	62.7 in²	78.6%	Support skirt
DC	55.8	62.7 in²	78.6%	Support skirt
DD	55.8	62.7 in²	78.6%	Support skirt
DE	55.8	62.7 in²	78.6%	Support skirt
DF	55.8	62.7 in²	78.6%	Support skirt
DG	219.2	77.3 in²	16.7%	CRD lines
DR	219.2	77.3 in²	16.7%	CRD lines
MRP1	30.0	98.1 in²	100%	None

TABLE 1: EXAMINATION COVERAGE

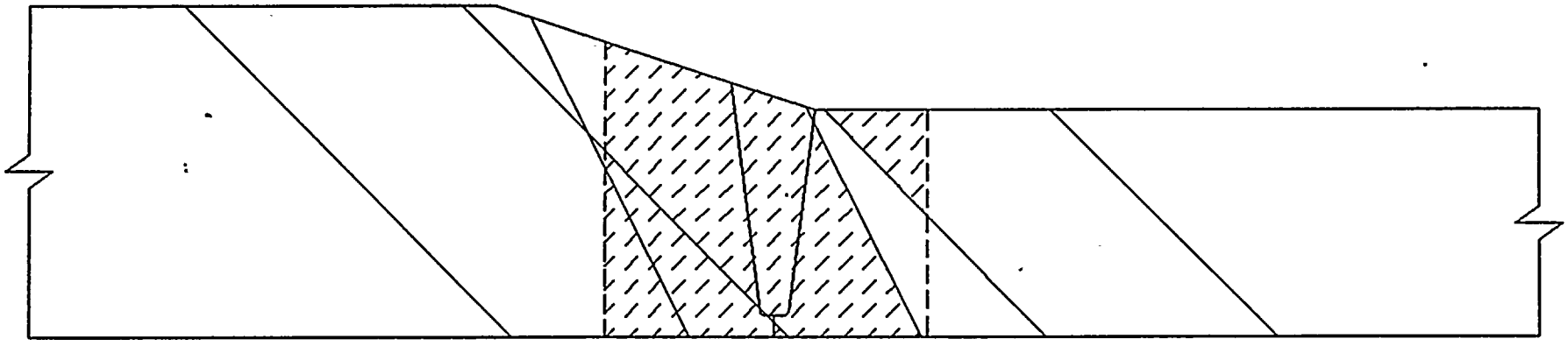
WNP-2
WELD AB
Code vol c/s area 70.5 in^2
0° weld metal scan
c/s area examined 53.0 in^2



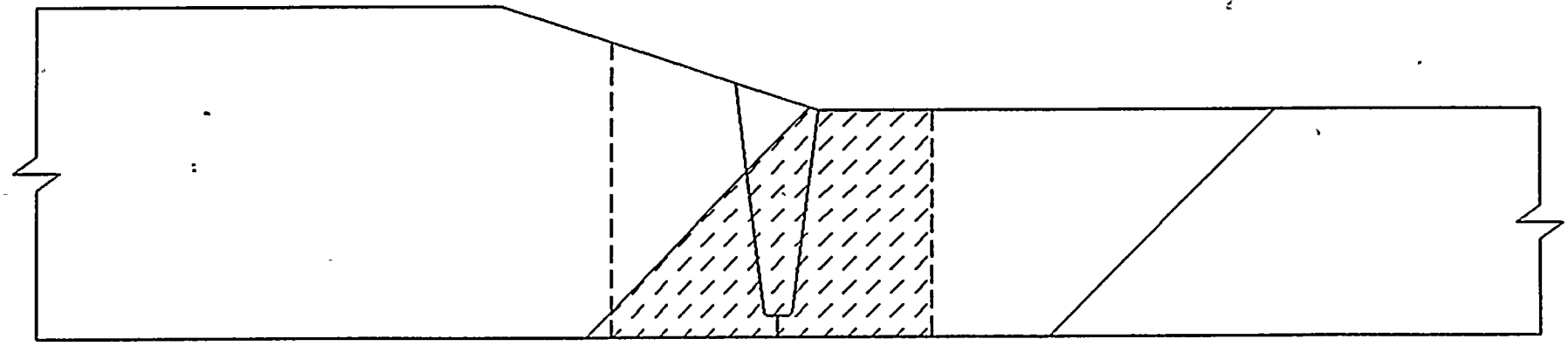
WNP-2
WELD AB
Code vol c/s area 70.5 in^2
45° and 60° P-scan
c/s area examined 59.8 in^2



WNP-2
WELD AB
Code vol c/s area 70.5 in^2
45° T-scan from bottom side
c/s area examined 54.5 in^2



WNP-2
WELD AB
Code vol c/s area 70.5 in^2
45° T-scan from top side
c/s area examined 46.8 in^2



WNP-2
WELD AB
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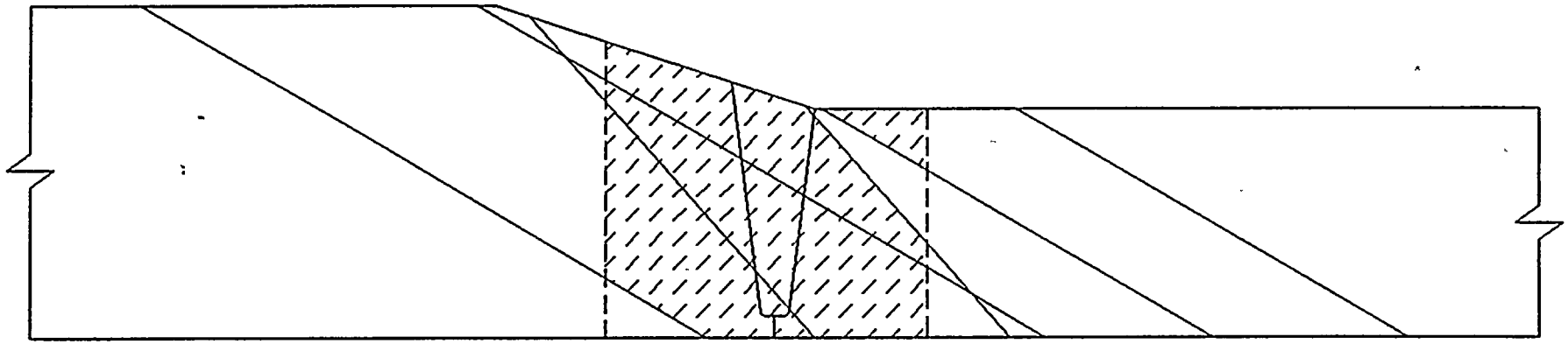
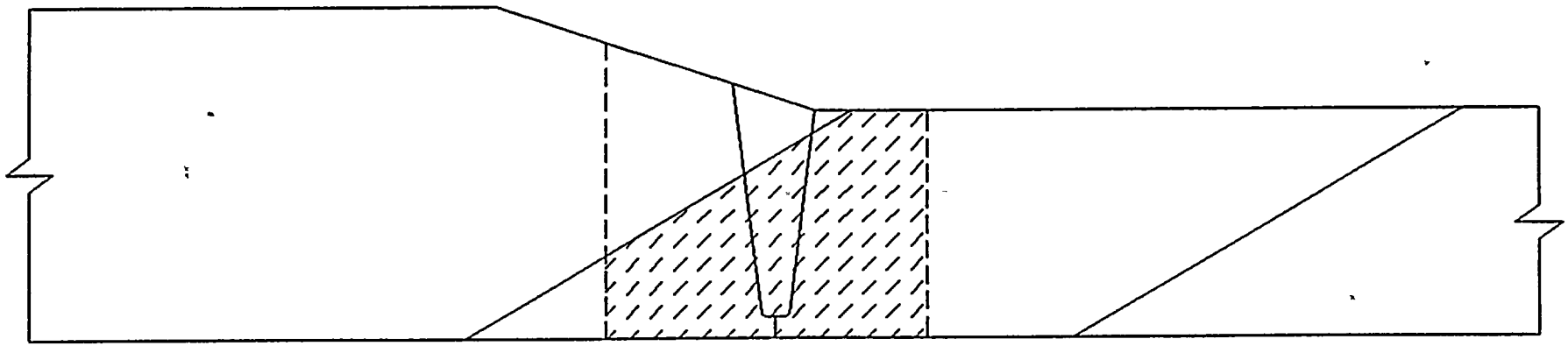
60° T-scan from bottom side
c/s area examined 65.3 in^2



WNP-2
WELD AB
Code vol c/s area 70.5 in^2
60° T-scan from top side
c/s area examined 46.8 in^2



ATTACHMENT 3

REQUEST FOR RELIEF NO. ISI-2-010

Component or System	ASME Class 1, Section XI Category B-D, item B3.90, pressure retaining welds in reactor pressure vessel. See table below.
Code	All of the subject welds were designed and fabricated to ASME Section III Class 1 1971 Edition, Summer 1971 Addenda. The inservice inspection is to be performed to the 1980 Edition Winter 1980 Addenda of ASME Section XI.
Number of Welds	Category: B-D; No.: 27
Section XI Requirements	Section XI requires that 100% of the examination volume defined in Figure IWB-2500-7(b) be examined.
Basis for Requesting Relief	Relief is required from ASME Section XI examination requirements on the basis of partial inaccessibility of the weld due to configuration. The design of the vessel to nozzle weld prevents examination of 100% of the volume defined in Figure IWB-2500-7(b) with today's available equipment.
Alternative Examinations	The accessible portion of each weld will be examined per Section XI requirements, augmented with Regulatory Guide 1.150 Revision 1, Appendix A requirements.
Impact on Plant Quality and Safety	There will be no adverse impact on plant quality and safety by doing only a partial Code examination of these welds.

1. The Class 1 RPV welds have passed radiographic, magnetic particle and ultrasonic examinations in accordance with Section III.
2. All of the identified welds will be subject to a system pressure test in accordance with Section XI Class 1 requirements.
3. Leak detection systems identify significant leakage in the areas of the subject welds. Appropriate operator action would occur due to leak detection system alarms.
4. No automatic inspection system in use today can effectively examine 100% of the required code volume. Additional manual examinations will not significantly increase, if at all, the volume examined.
5. The Section XI weld examinations will be augmented by Regulatory Guide 1.150 Revision 1, Appendix A requirements.
6. The achievable coverage will detect flaws in the inner volume where they are most likely to occur.

REQUEST FOR RELIEF NO. ISI-2-010

Table of Weld Coverage

Nozzle Number	Description	Number of Nozzles	% Volume Examined 45 Degree	% Volume Examined 60 Degree
N1	Reactor Recirculation Outlet	2	75	81
N2	Reactor Recirculation Inlet	10	75	81
N3	Main Steam	4	86	90
N4	Feedwater	6	71	79
N5	Low Pressure Core Spray	1	86	90
N6	Low Pressure Core Injection (RHR)	3	72	79
N16	High Pressure Core Spray	1	72	80

Documentation Supporting Relief Request 2-ISI-010

Following is the coverage report prepared for WNP-2 by General Electric at the conclusion of refueling outage R-7 RPV nozzle to vessel examinations. This report is provided to support the commission's review of this relief request. Included in the report is a table listing the coverage obtained during R-7 and coverage plates.

Following General Electric coverage report is a coverage plot for nozzle to vessel weld for N3, main steam. The N3 nozzle to vessel welds were done manually between outages R-2 and R-7.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
WASHINGTON NUCLEAR PLANT - UNIT 2

COVERAGE REPORT

I. INTRODUCTION

This document describes the capability of General Electric's automated RPV inspection system (GERIS) to meet the requirements of Regulatory Guide 1.150 paragraphs 7.b and 7.c and 10 CFR 50-55a(g).

Examination techniques described in this report are those used by General Electric when performing automatic ultrasonic inspections on ASME Code category B-D nozzle to vessel attachment welds and adjoining base material regions, and nozzle inner radius areas. Scanning coverage documented in this report is for nozzle forging (flange type) to vessel welds. The ASME Boiler and Pressure Vessel Code referenced in this report is the 1980 Edition, Winter 1980 Addenda.

No automated inspection system in use today is capable of effectively examining 100% of the ASME Code examination volume defined in Section XI - IWB 2500-7(b). This fact has been recognized in that the NRC Regulatory Guide 1.150 requires that volumes that are not examined be defined and documented in the examination report.

Manual examination of areas inaccessible to the automatic equipment due to nozzle geometry (excluding areas inaccesible due to restrictive adjacent nozzles) would yield only a small increase in the volume examined. Complete coverage would still not be attained.

II. ASME CODE AND REGULATORY GUIDE 1.150 REQUIREMENTS

Section 50.55a, "Codes and Standards," of 10 CFR Part 50 requires that Class I components per American Society for Mechanical Engineers Boiler and Pressure Vessel Code (ASME B&PV Code) meet the requirements set forth in Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the ASME Code.

Section XI IWB-2500-1 requires that nozzle to vessel and vessel seam welds be examined by volumetric inspection techniques.

Nozzle-to-Vessel Welds

For nozzle to vessel welds, the area to be volumetrically examined per figure IWB-2500-7(b) is defined as the weld metal plus adjacent base material regions as shown in Figure 1.

Nozzle Inner-Radius and Bore

For the nozzle inner radius region, the area to be examined per Figure IWB-2500-7(b) is defined as the inner 1/2 inch of the inner radius and the nozzle bore through to vessel wall thickness. This region is identified in Figure 2 as Zone 1 and Zone 2A. The nozzle bore extends out from the end of the inner radiou section to the end of the cylindrical portion of the nozzle; this region is identified in Figure 2 as Zone 2B and Zone 3.

For volumes that are inaccessible to the transducer, or volumes shadowed by part geometry that have not been effectively examined, Regulatory Guide 1.150 paragraph 7.b requires that a best estimate of the affected volume be reported along with the ultrasonic examination results.

III. AUTOMATED NOZZLE AND VESSEL SCANNER

EQUIPMENT DESCRIPTION

Nozzle to Vessel Weld and Nozzle Inner Radius Scanner

The nozzle device, mounted on a channel track clamped around the nozzle OD cylindrical surface, provides the means of performing a remote ultrasonic examination of the nozzle welds (see Figure 3). The nozzle device includes the nozzle tractor, scanner arm and transducer package.

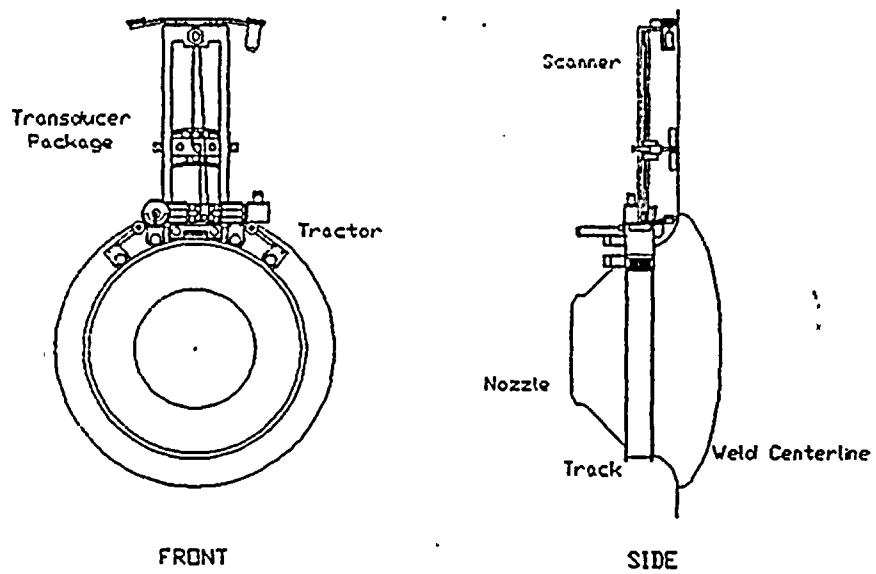


Figure 3
Nozzle Tractor and Scanner

The nozzle tractor consists of a main body with two motor driven magnetic wheels and two hinged end sections, each with one motor driven magnetic wheel assembly. A pendulum and resolver are mounted on the main body to give the angular position of the nozzle tractor. The reciprocating scanner arm is attached to the nozzle tractor and extends perpendicular to the nozzle track for scanning the nozzle to vessel welds and nozzle inner radius.

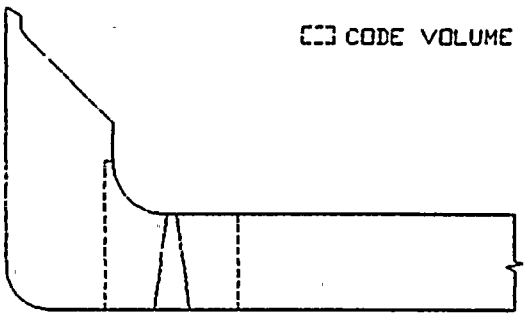


Figure 1
Nozzle Weld Examination Volume

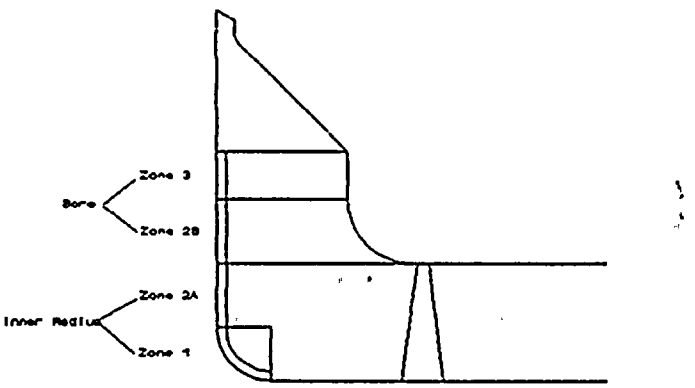


Figure 2
Nozzle Inner Radius and Bore Examination Volume

Ultrasonic examinations are performed according to Article 4 "Ultrasonic Examination When Dimensioning of Indications is Required" of Section V. Scanning is performed by angle beam and straight beam techniques per paragraphs T-441.5 through T-441.7 wherever such scanning is feasible.

The United States Nuclear Regulatory Commission (NRC) has issued Regulatory Guide 1.150, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations", to assure improved pressure vessel inspections. The recommendations of this guide are supplemental to the requirements of Section XI.

The scanner arm consists of a frame, two tandem mounted stepping motors, a worm gear driven resolver, and a ball screw driven plate which holds the ultrasonic transducer package. The scanner arm is held to the vessel wall with two spring loaded guide rods on the inboard end and two magnetic wheels mounted at the outboard end of the scanner arm. The transducer package consists of a combination of various transducer wedges individually mounted in a frame. The wedges produce beam angles as required by Section V. To improve coupling efficiency, a specially designed soft rubber-faced transducer wedge is used.

EXAMINATION TECHNIQUES

Nozzle to Vessel Welds

The accessible examination volume of nozzle to vessel welds is examined by using two types of scanning packages as described below.

The T-scan (shear wave sound beam transverse to the weld axis) transducer package consists of 45° and 60° angle beam wedges (see Figure 4). The 45° and 60° angle beam wedges are angulated to produce a sound beam that is perpendicular to the weld centerline at the vessel inner surface.

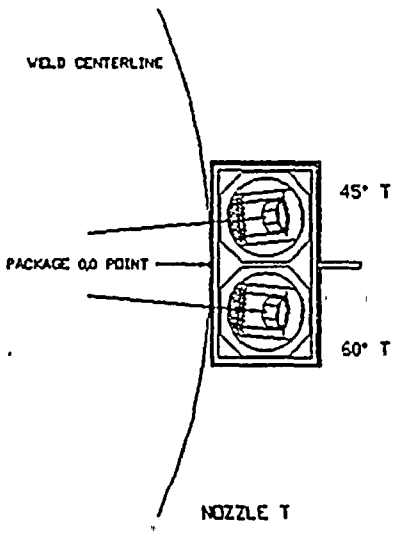


Figure 4
T-Scan Transducer Package

One complete revolution of the nozzle scanner with the T-scan package will scan the accessible examination volume for parallel oriented reflectors using a 45° and 60° angle beam. The P-scan (shear wave sound beam parallel to the weld axis) transducer package consists of 45° and 60° angle beam wedges. The wedges are angulated to produce a sound beam that is tangent to the weld centerline at the vessel inner surface. The P1-scan consists of a 45° angle beam pointed in the

counterclockwise direction and a 60° angle beam pointed in the clockwise direction. For the P2-scan the 45° is pointed in the clockwise direction and the 60° in the counterclockwise direction (see Figure 5).

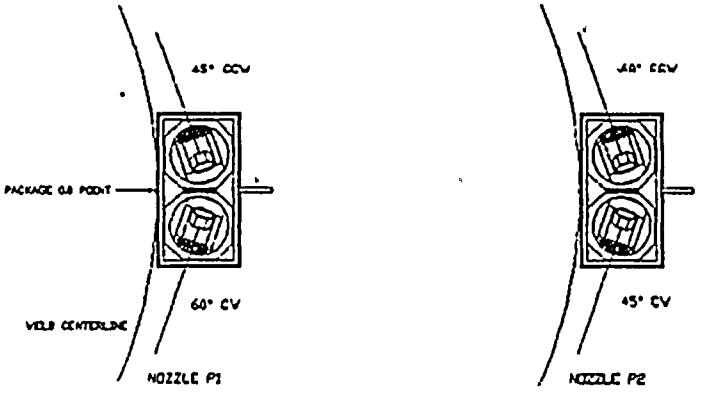


Figure 5
P-scan Transducer Package

Two complete revolutions of the nozzle scanner, one revolution with the P1 package and one revolution with the P2 package are performed to scan (from two directions) the accessible examination volume for transverse oriented reflectors.

The L-wave scan (0° longitudinal wave) transducer package consists of a 0° longitudinal wave transducer (see Figure 6).

One complete revolution of the nozzle scanner with the L wave package will scan the accessible examination volume for planar and laminar reflectors using a 0° straight beam.

Nozzle Inner Radius and Bore

The nozzle inner radius and bore are divided into two zones, identified as Zone 1 and Zone 2A. Each zone is examined by a separate testing technique. Each examination technique has its own unique transducer array.

Zone 1 Examination

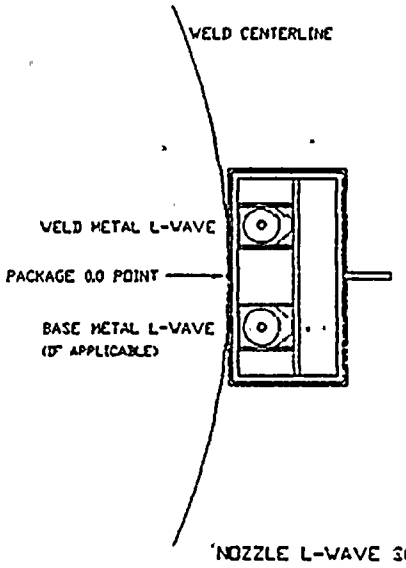


Figure 6
L-wave Transducer Package

The nozzle inner radius is examined from the vessel plate with a refracted shear wave that passes through the nozzle to vessel weld (see Figure 7).

Beam and rotation angles are calculated assuming the sound beam incident point is located 4 inches out from the vessel to nozzle outer radius tangent point where the sound beam lies in a plane 45 to 60 degrees to the vertical as viewed along the nozzle axis. The axial reflector location is at the center of the nozzle inner radius located at the top dead center of the nozzle.

When wedges are not available to meet the exact wedge design criteria, wedges are selected with closely matched sound beam angles. The incident point and rotation angles are then recalculated using the selected beam angle.

Zone 2A Examination (Nozzle Scanner)

The Zone 2A area of the nozzle bore as shown in figure 3 is examined with refracted shear waves from the surface where the nozzle OD blend radius merges with the cylindrical surfaces of the RPV. This scan is performed with the nozzle scanner.

The sound beam and rotation angles are calculated assuming that the incident point of the sound beam is located on the nozzle OD blend radius adjacent to the vessel surface and the axial reflector location is located at the intersection point of Zones 2A and 2B. The Zone 2A transducer is designed to perform scanning from the nozzle OD blend radius. Typically, coverage extends from the Zone 1

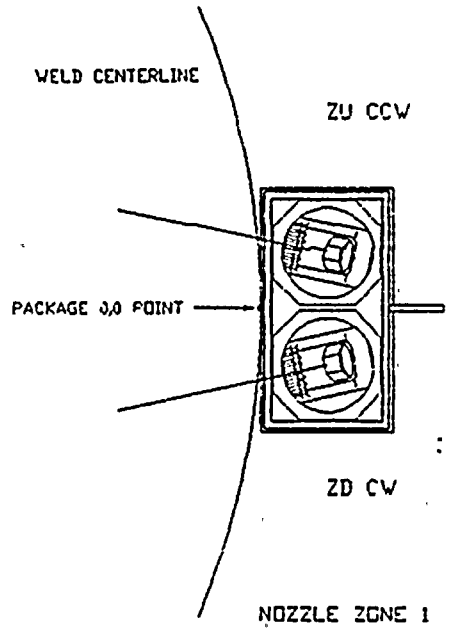


Figure 7
Zone 1 Transducer Package

region well into the Zone 2B area.

One complete revolution of the nozzle scanner with two Zone 2A transducers, one directed in the clockwise direction and the other in the counter-clockwise direction scans the accessible Zone 1 and Zone 2A examination volume for axial reflectors.

IV. SCANNING COVERAGE

The flanged nozzle design when examined from the outside vessel surface does not allow a full volumetric inspection of the volume specified in Figure IWB-2500-7(b). The main limitation is the fact that the volume can only be examined from one side.

Scan Limitations and Volume of Coverage.

Table 1 summarizes the examined volume from the coverage plots in Appendix A. Note that the area not examined due to near field effects, which has been determined to be the outer 0.5" of the examination volume, has been excluded from the 'Volume Examined' percentages in the table.

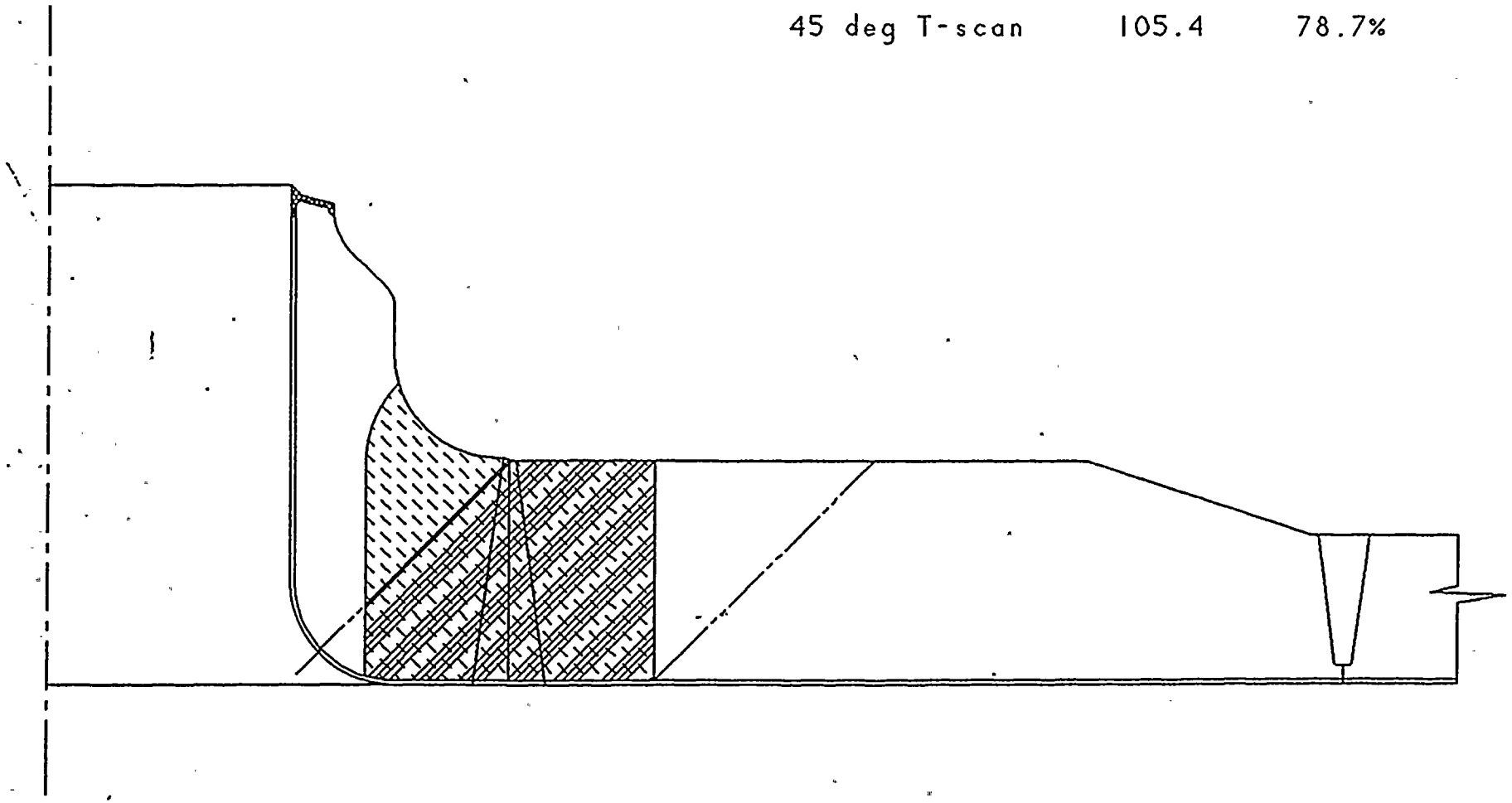
Summary sheets and data sheets for four N2 nozzles (N2-90, N2-120, N2-270, and N2- 300) list a restriction on the 60° T-scan by N9 nozzles. This is a restriction on the intended scanning area only. At the outer pulsing limit, the 60° beam intersects the ID surface 1.1" outside the edge of the weld. This does not constitute a restriction of coverage for Code purposes.

The figures show the extent of scan coverage attained on all scans of all seven nozzle types examined. These figures treat the sound beam as a single ray and take no credit for beam spread. Coverage is taken as that portion of the cross-sectional area of the Code volume (including the outer 0.5", as shown in the figures) which is actually intersected by the sound beam. Results for the 0° weld metal examination, 45° & 60° T-scans (transverse to the weld), 45° & 60° P-scans (parallel to the weld), and the inner radius section are shown.

WNP-2 N1
Recirc Outlet

Code vol c/s area 134.0 in^2

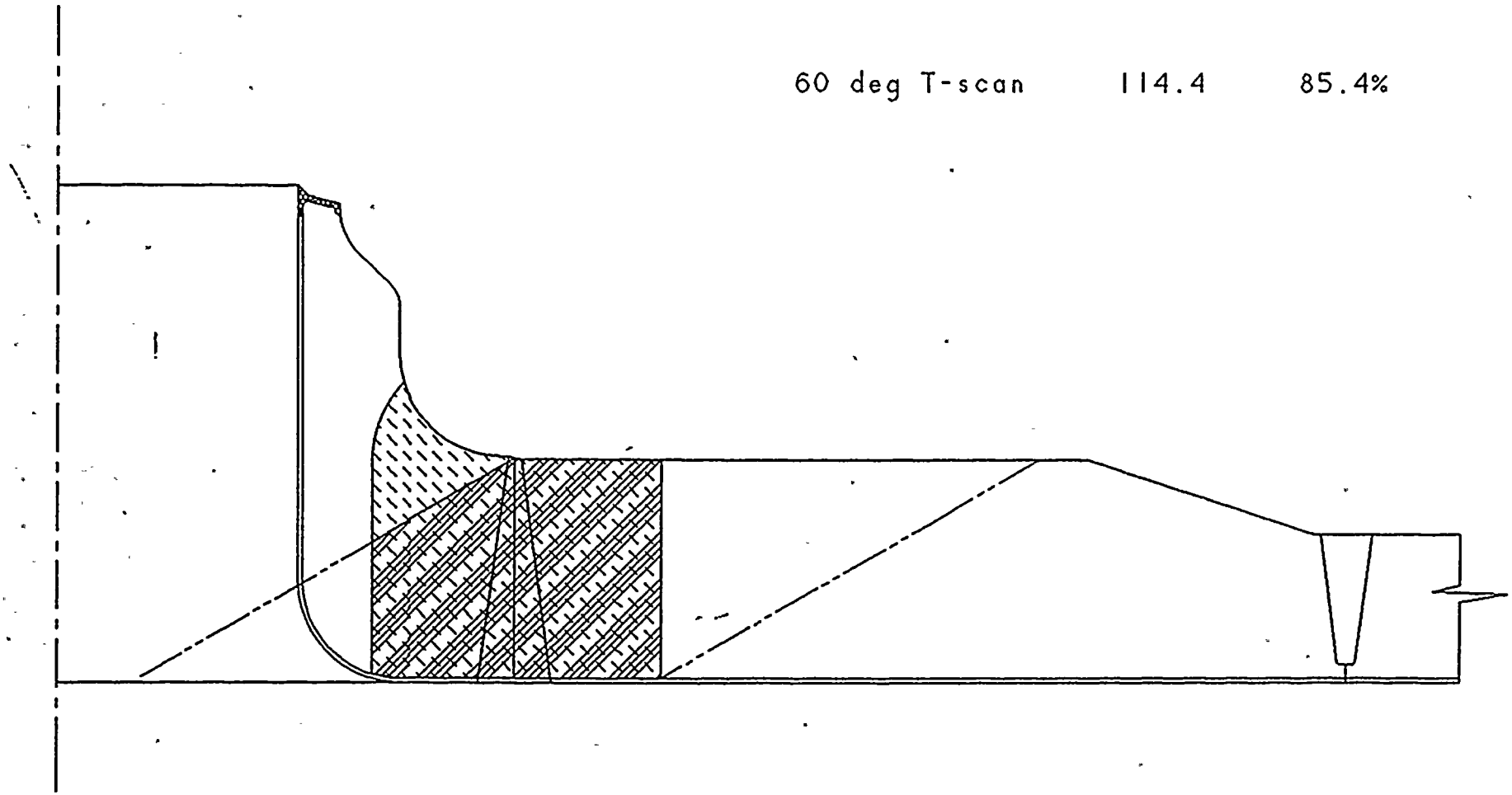
45 deg T-scan 105.4 78.7%



WNP-2 N1
Recirc Outlet

Code vol c/s area 134.0 in^2

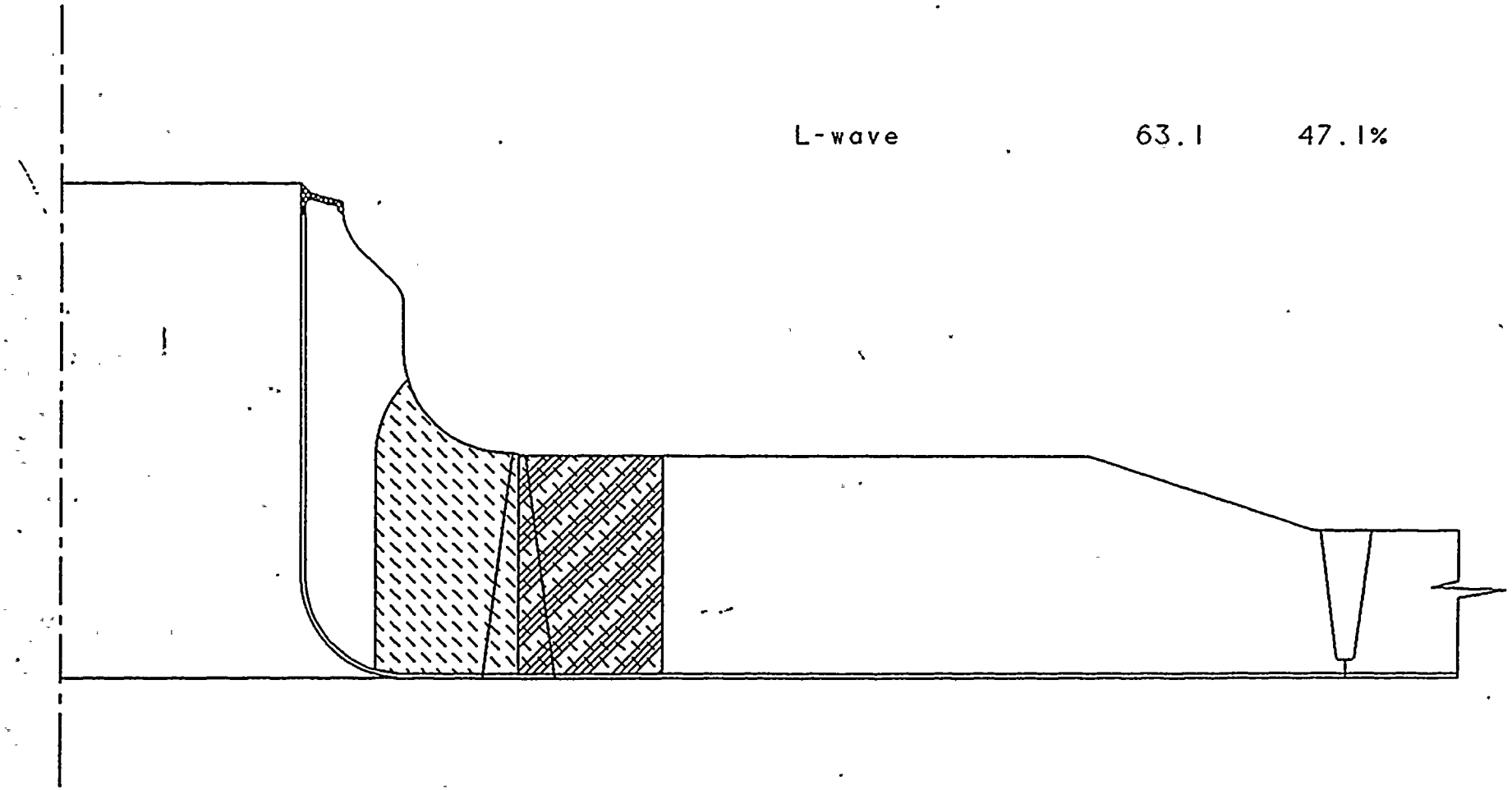
60 deg T-scan	114.4	85.4%



WNP-2 N1
Recirc Outlet

Code vol c/s area 134.0 in^2

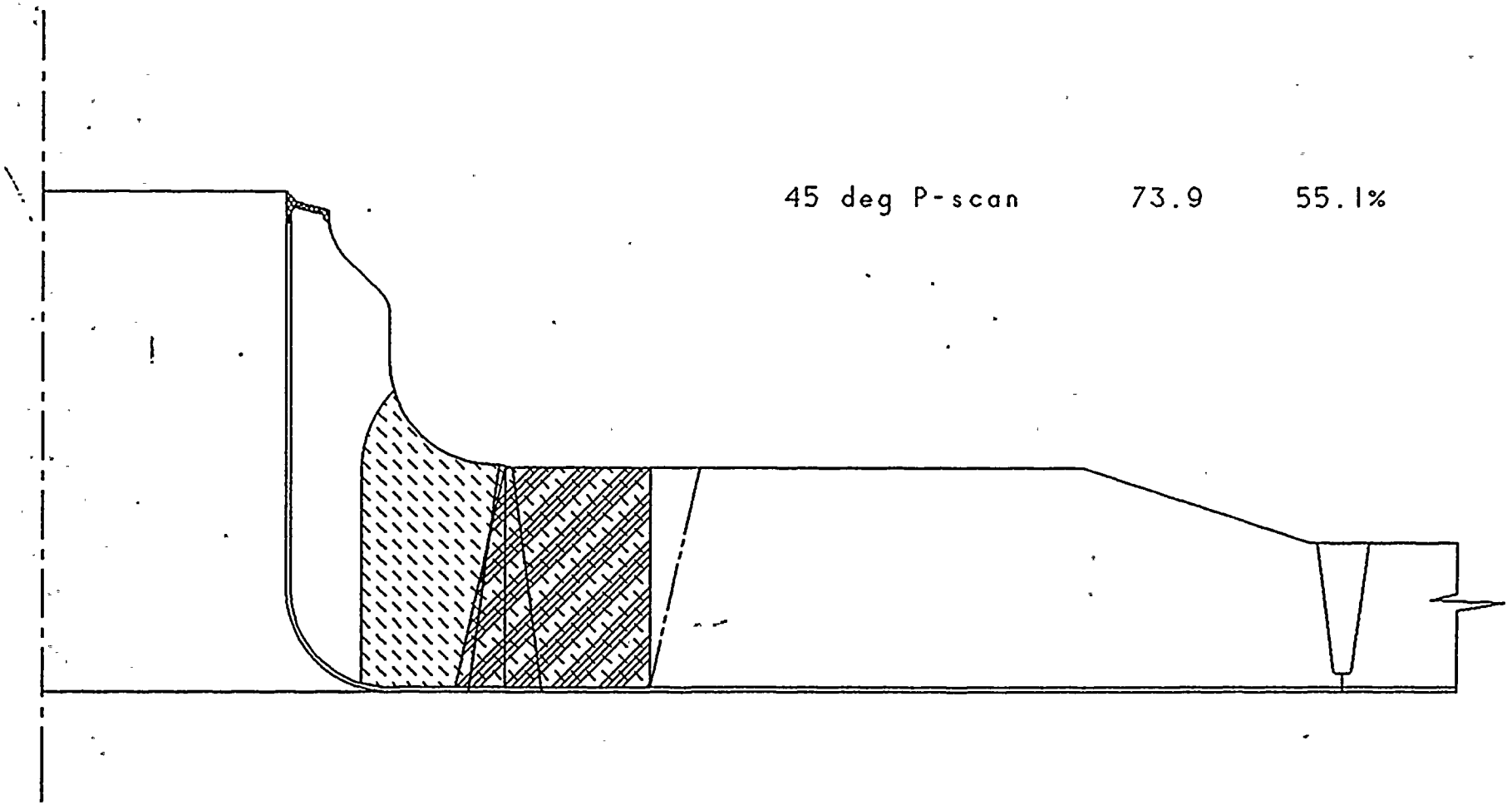
L-wave	63.1	47.1%



WNP-2 N1
Recirc Outlet

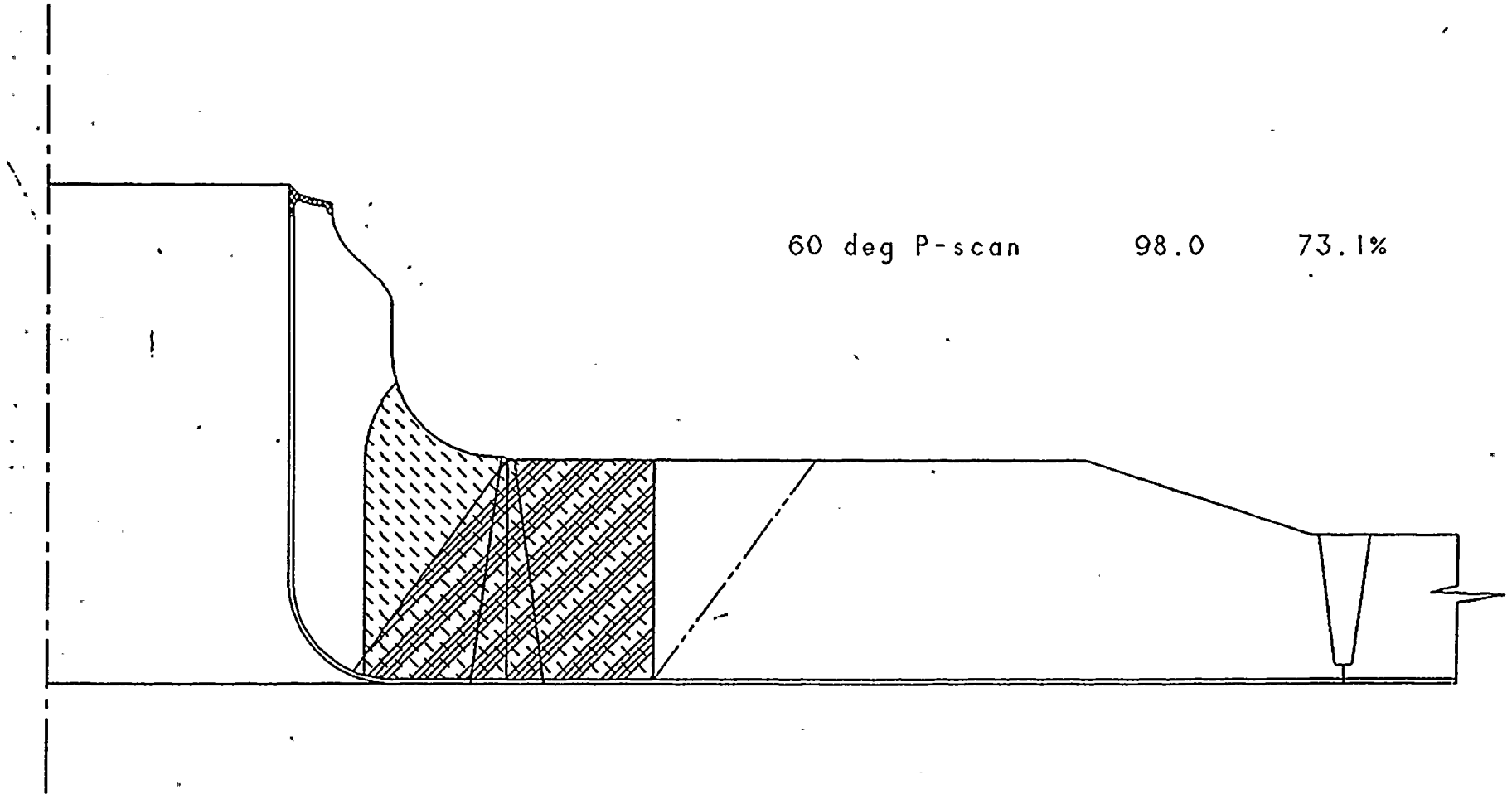
Code vol c/s area 134.0 in^2

45 deg P-scan	73.9	55.1%



WNP-2 N1
Recirc Outlet

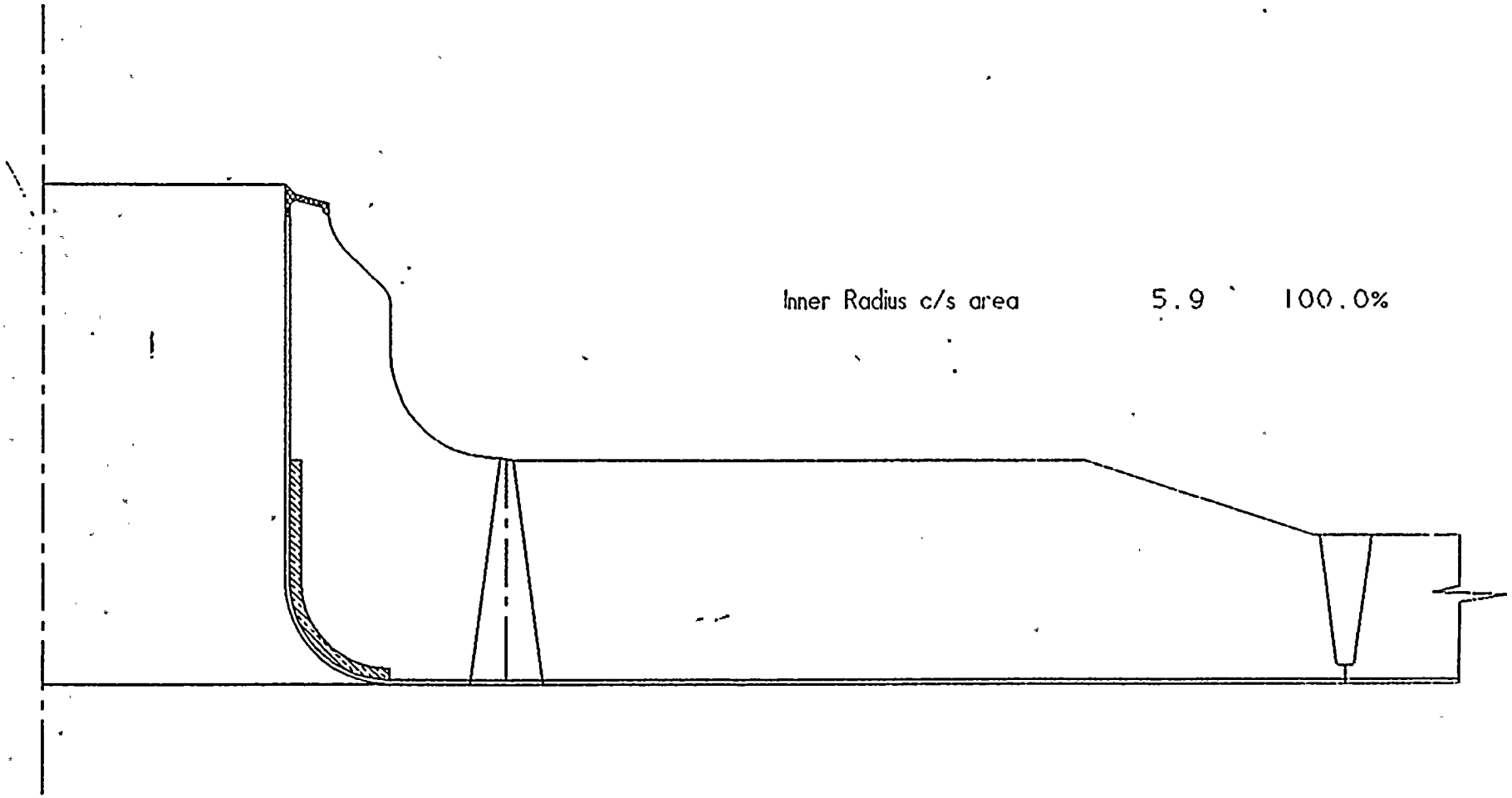
Code vol c/s area 134.0 in^2



60 deg P-scan 98.0 73.1%

WNP-2 N1
Recirc Outlet

Code vol c/s area 134.0 in^2

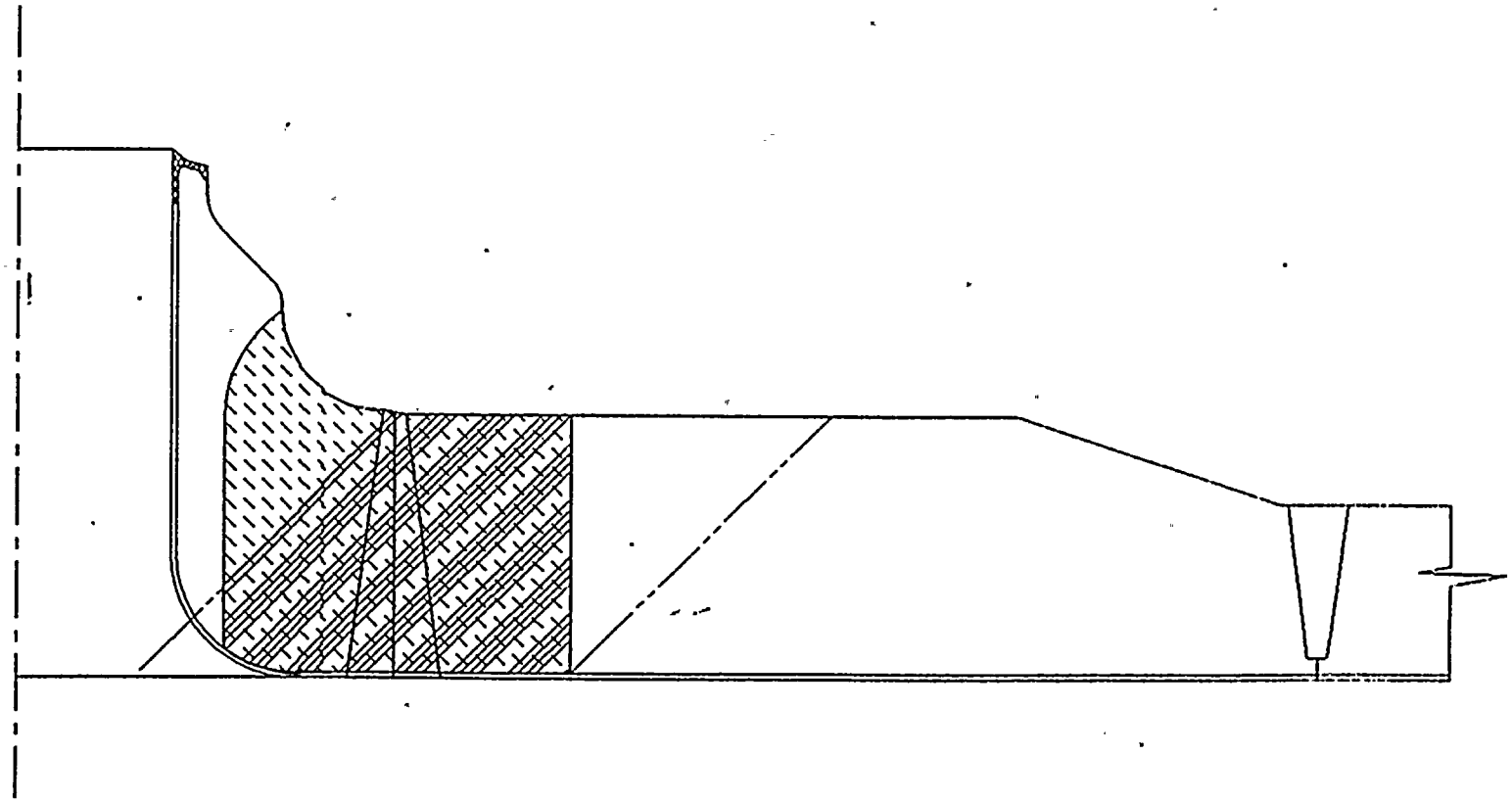


Inner Radius c/s area 5.9 100.0%

WNP-2 N2
Recirc Inlet

Code vol c/s area 135. in^2

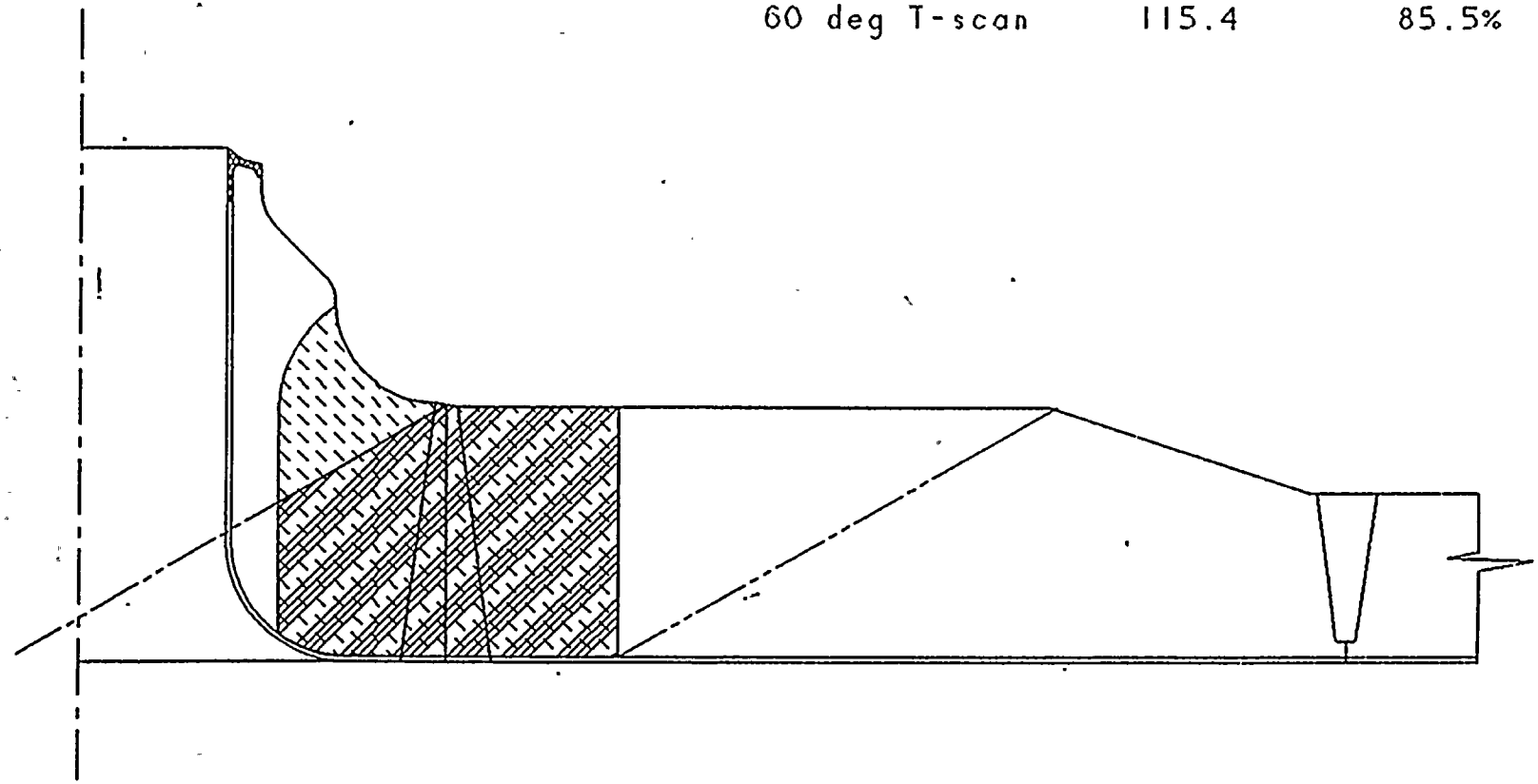
45 deg T-scan . 106.6 79.0%



WNP-2 N2
Recirc Inlet

Code vol c/s area 135. in^2

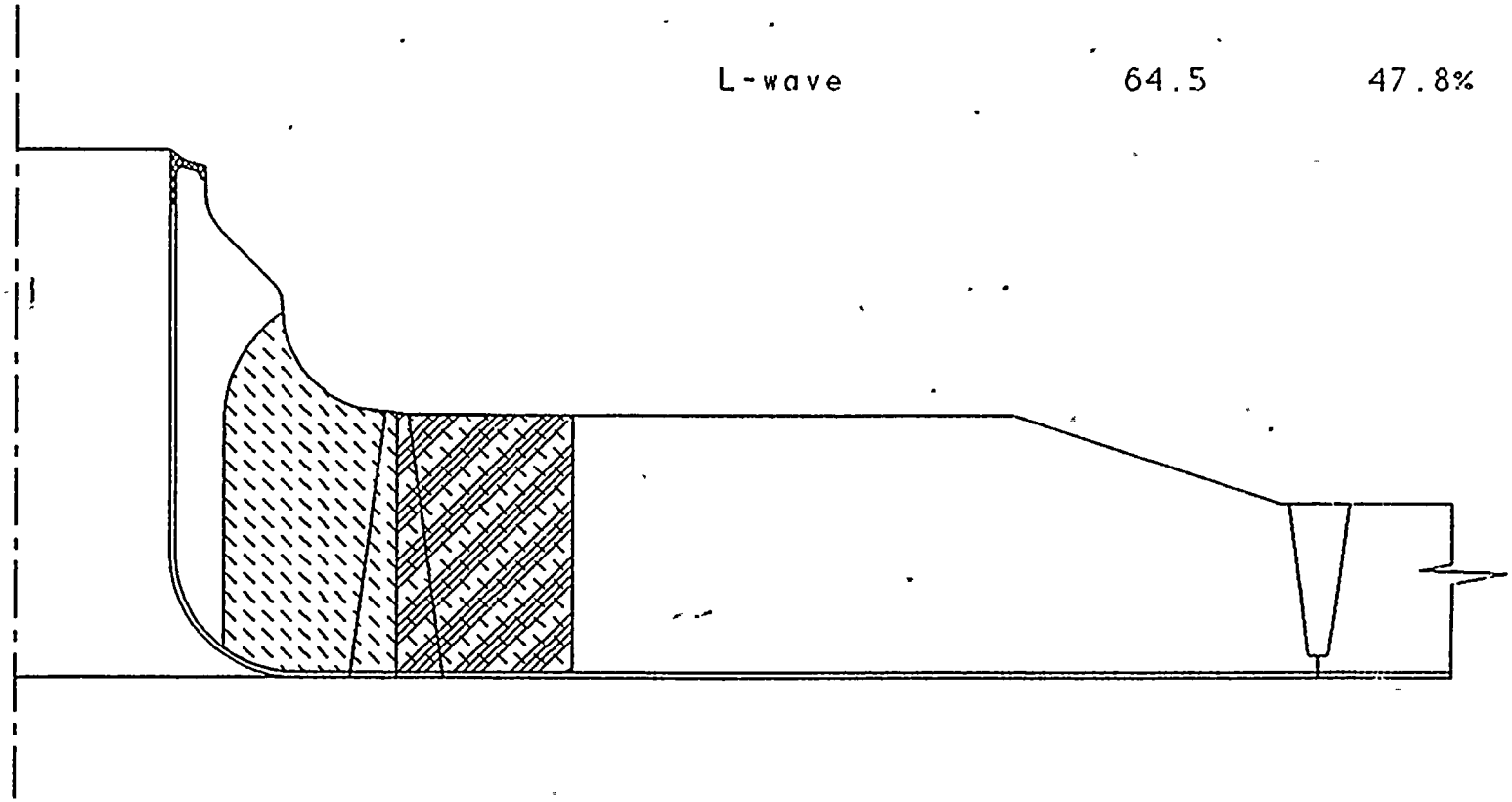
60 deg T-scan	115.4	85.5%



WNP-2 N2
Recirc Inlet

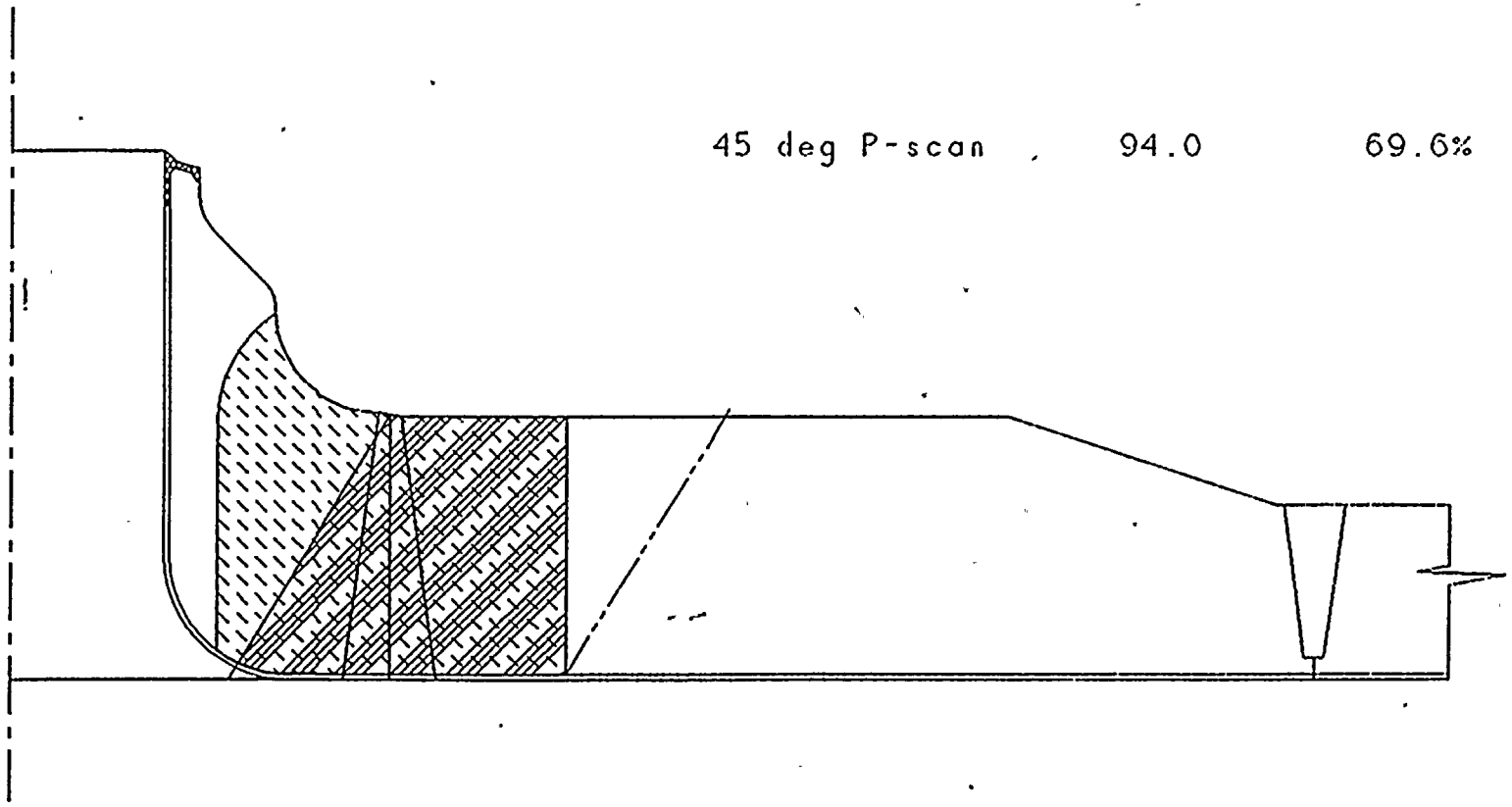
Code vol c/s area 135. in^2

L-wave	64.5	47.8%



WNP-2 N2
Recirc Inlet

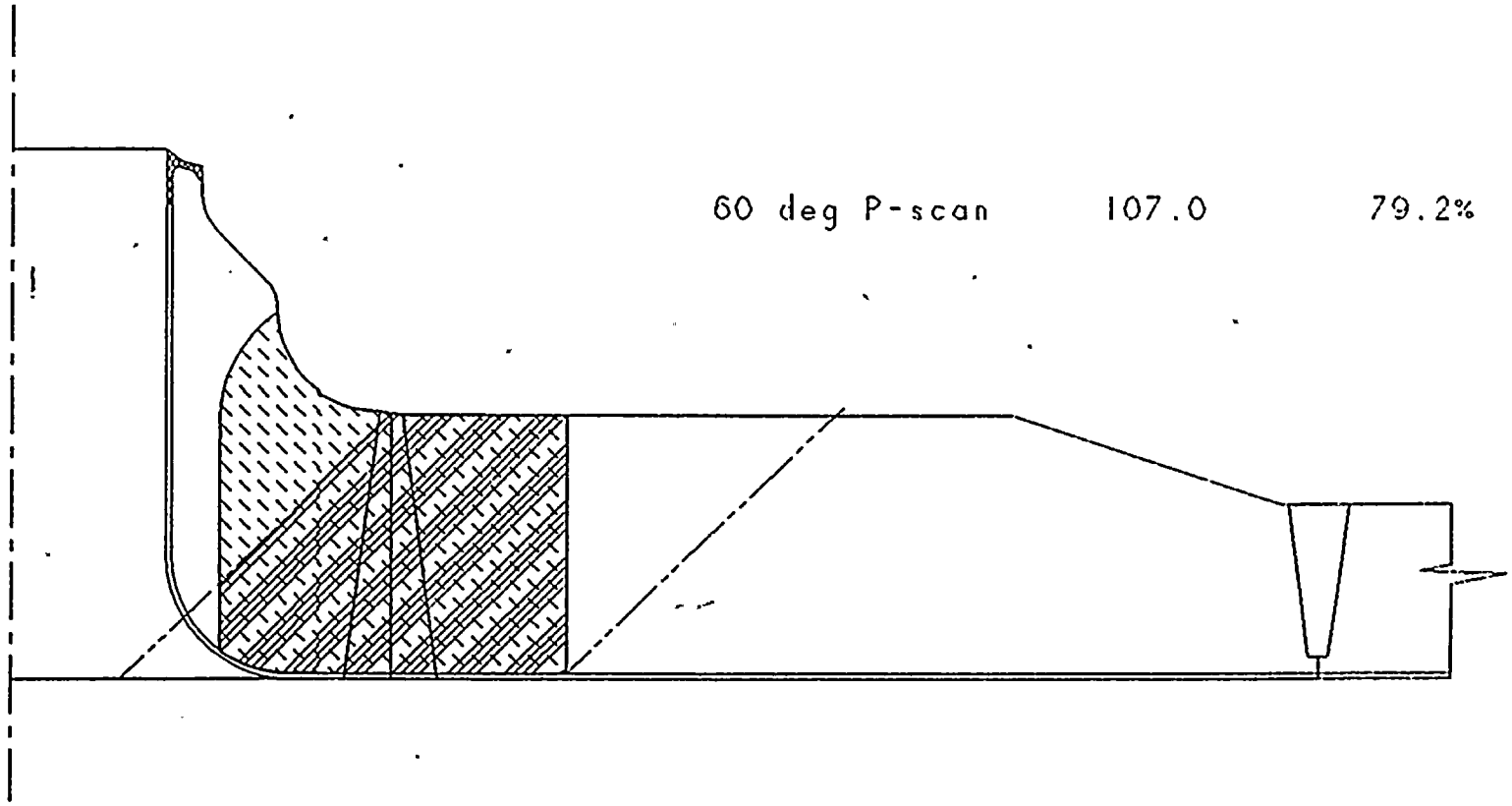
Code vol c/s area 135. in^2



45 deg P-scan	94.0	69.6%

WNP-2 N2
Recirc Inlet

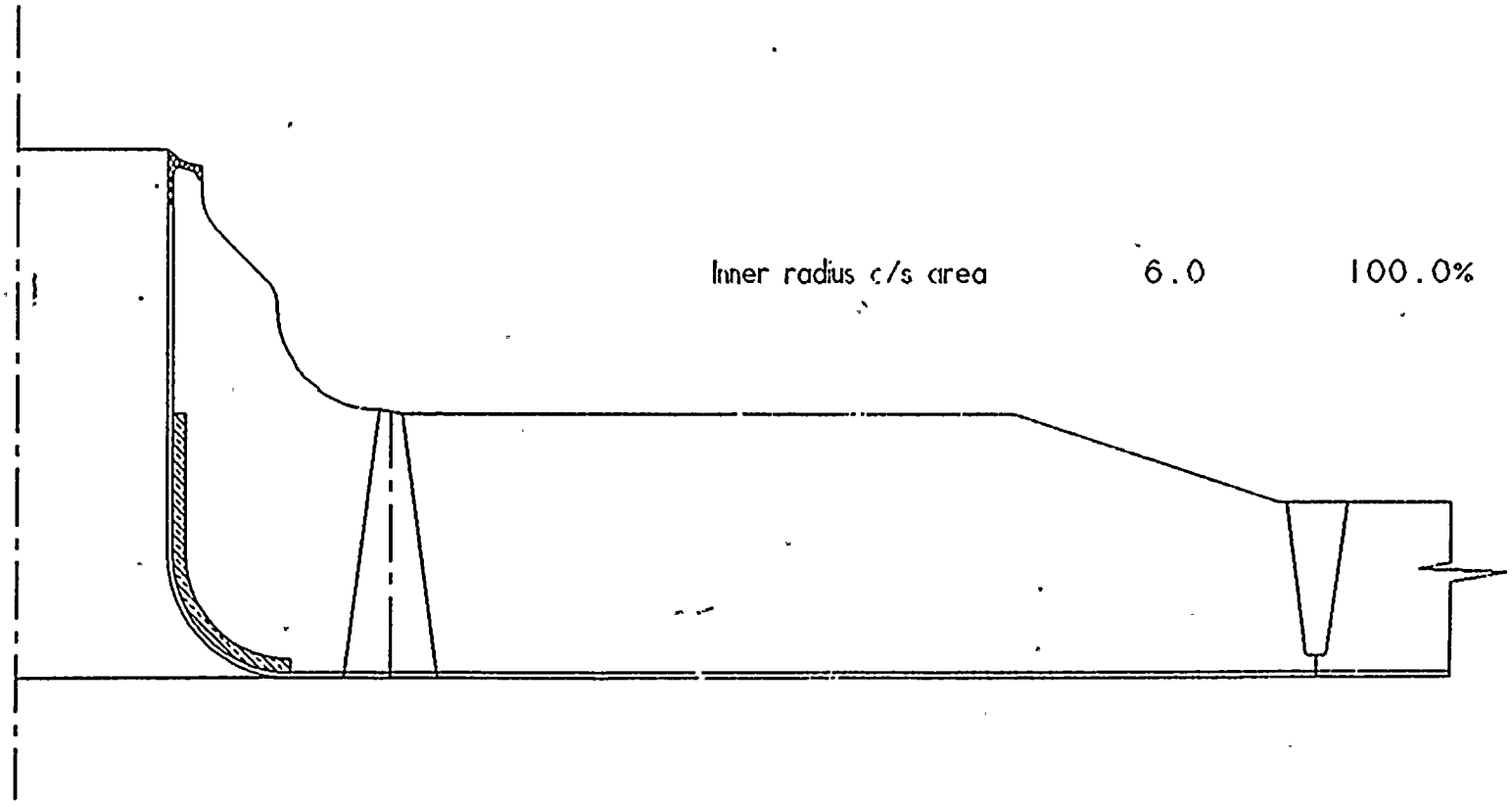
Code vol c/s area 135. in^2



60 deg P-scan	107.0	79.2%

WNP-2 N2
Recirc Inlet

Code vol c/s area 135. in^2

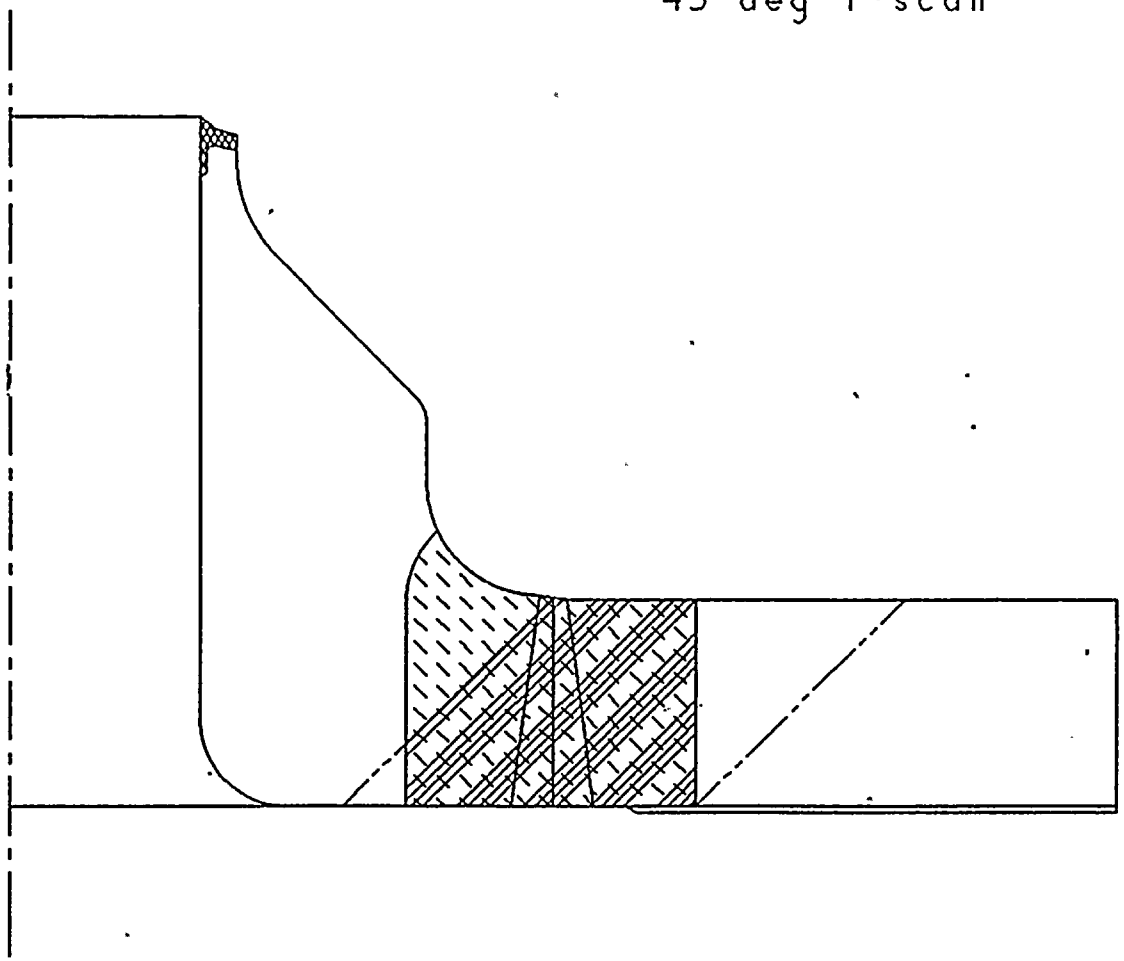


Inner radius c/s area	6.0	100.0%

WNP-2 N4
Feedwater

Code vol c/s area 64.2 in^2

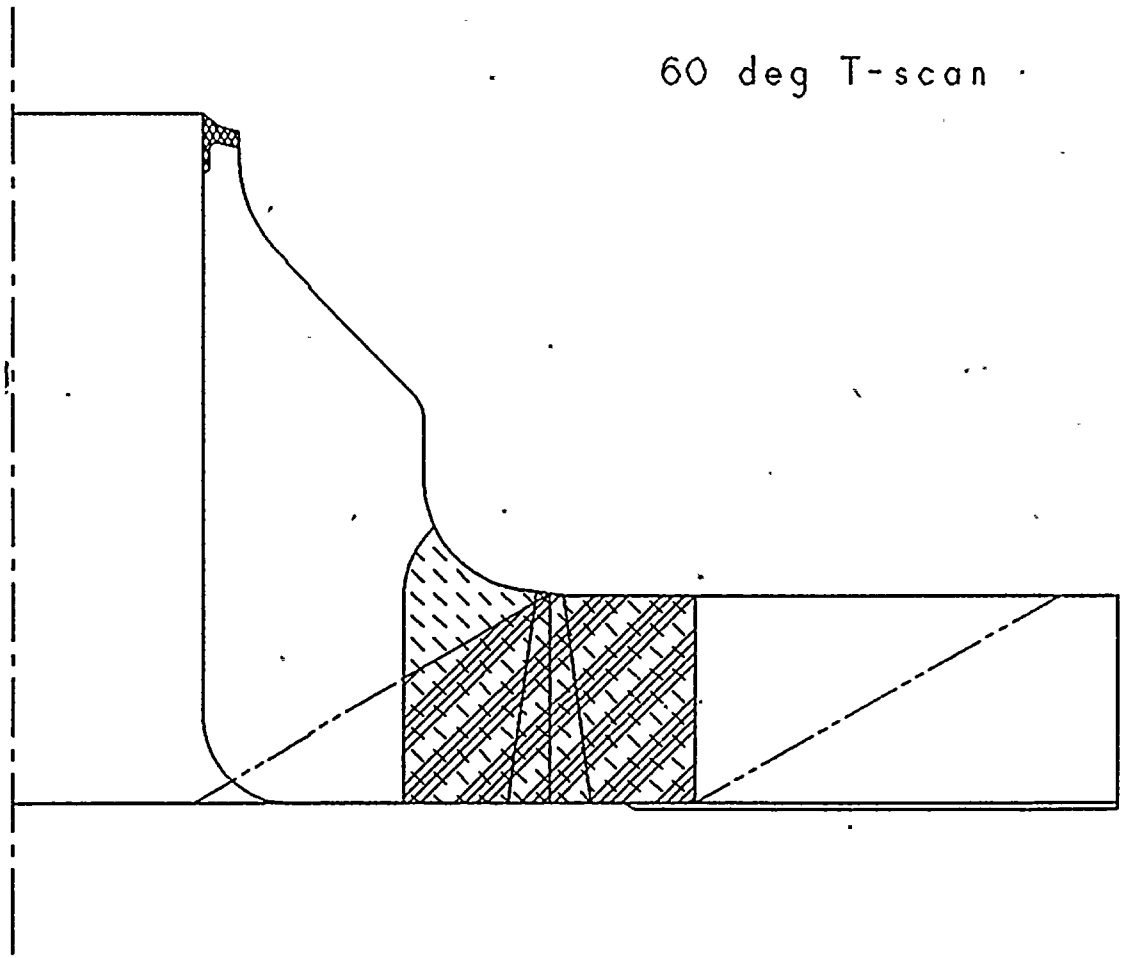
45 deg T-scan 49.4 76.9%



WNP-2 N4
Feedwater

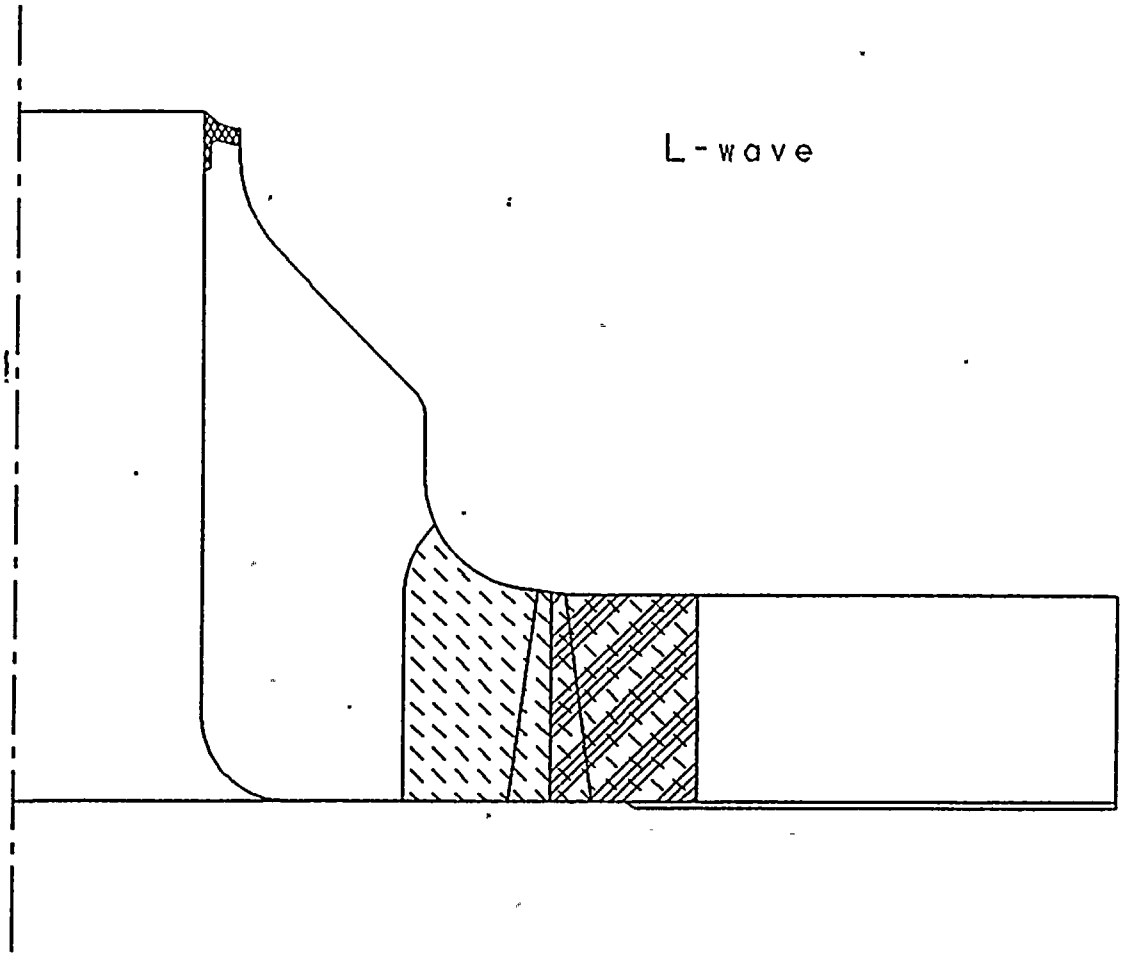
Code vol c/s area 64.2 in^2

60 deg T-scan 54.1 84.2%



WNP-2 N4
Feedwater

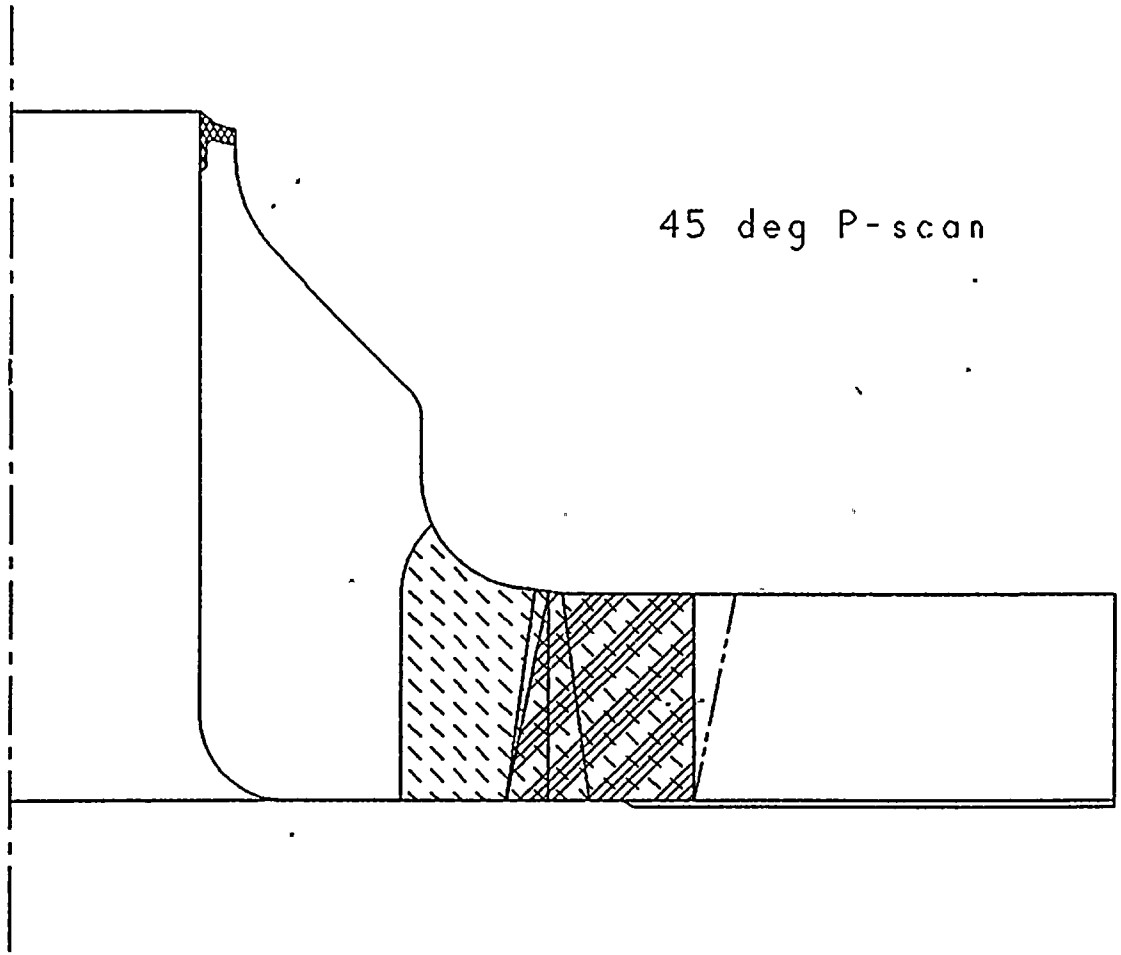
Code vol c/s area 64.2 in^2



L-wave	30.1	46.9%

WNP-2 N4
Feedwater

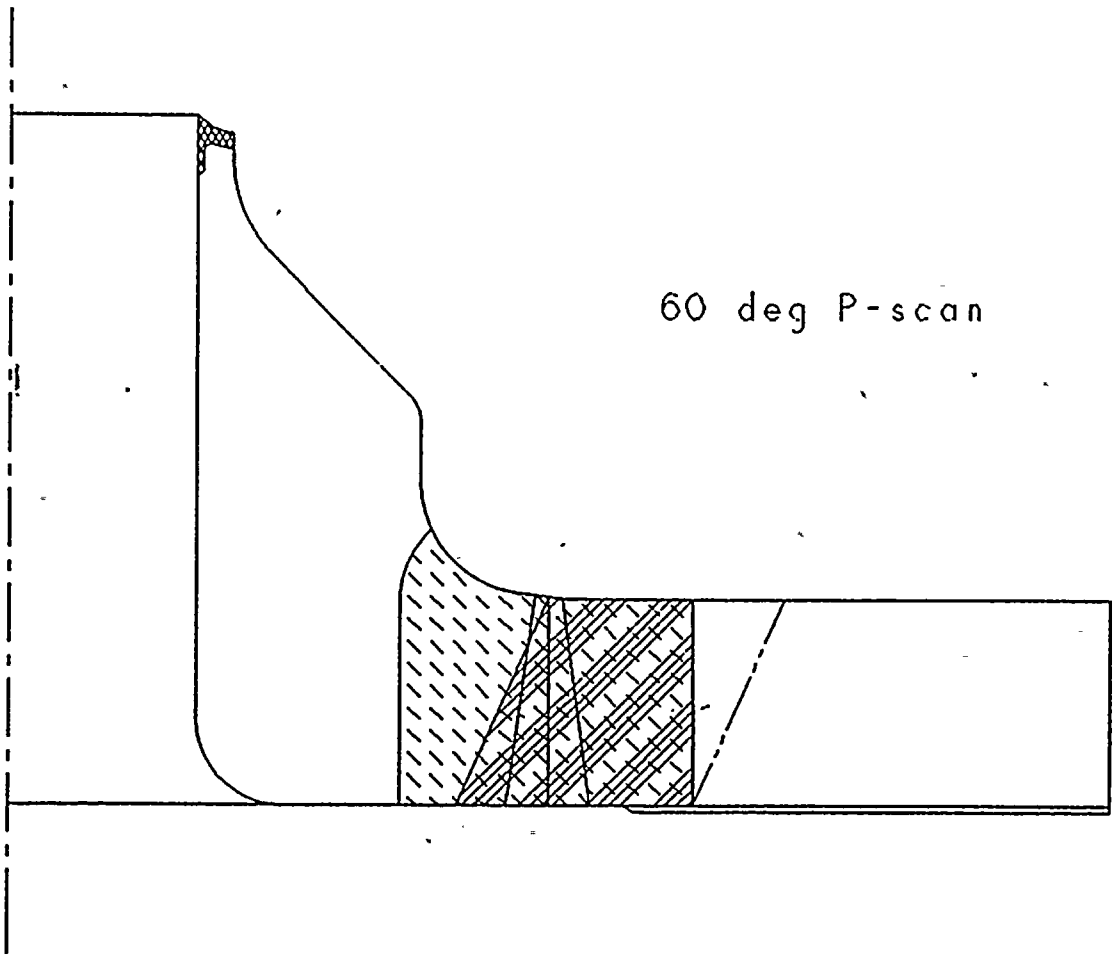
Code vol c/s area 64.2 in^2



45 deg P-scan	34.5	53.7%

WNP-2 N4
Feedwater

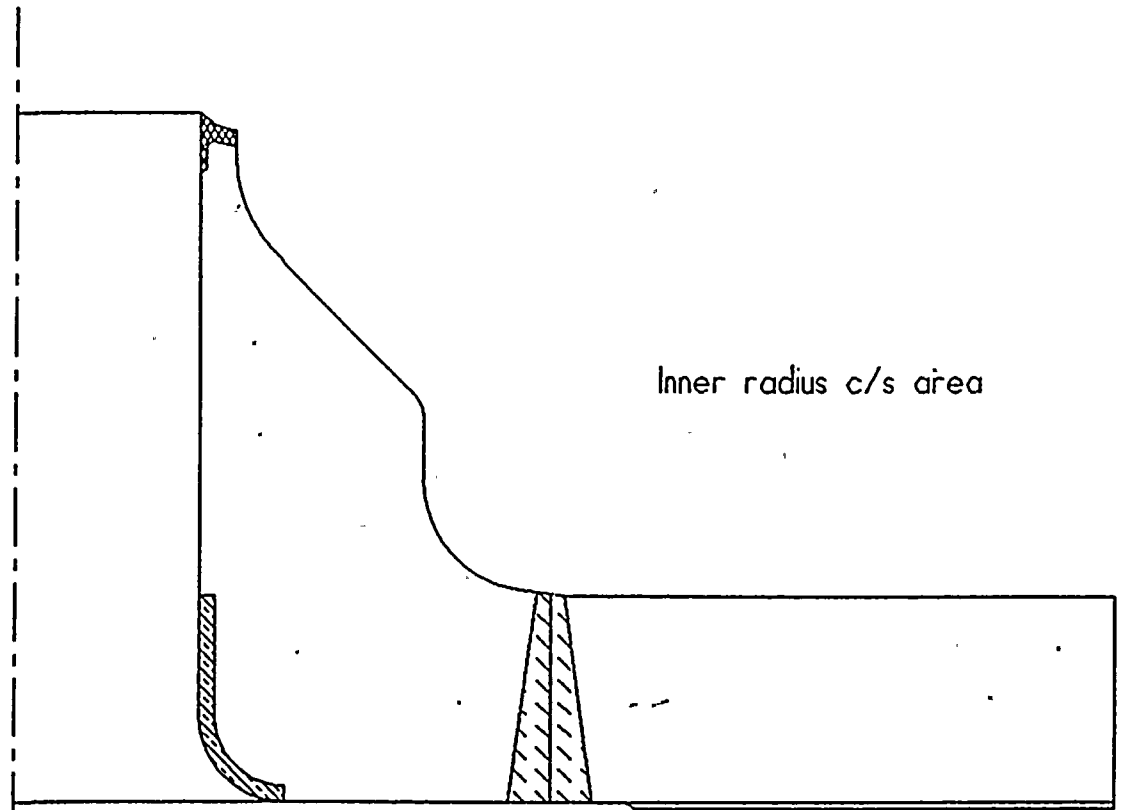
Code vol c/s area 64.2 in^2



60 deg P-scan 39.6 61.7%

WNP-2 N4
Feedwater

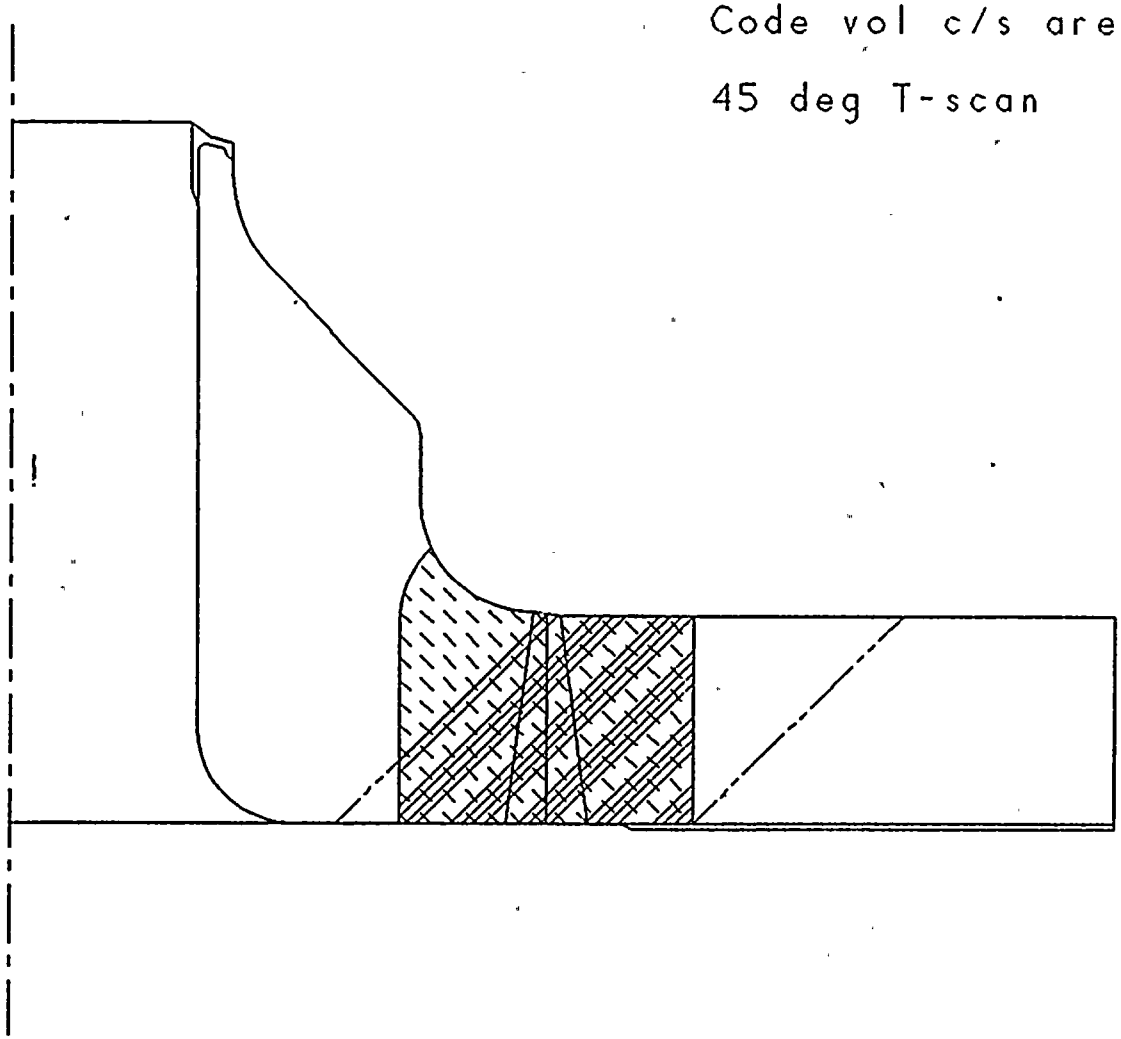
Code vol c/s area 64.2 in^2



Inner radius c/s area	3.9	100.0%

WNP-2 N6
RHR/LPCI

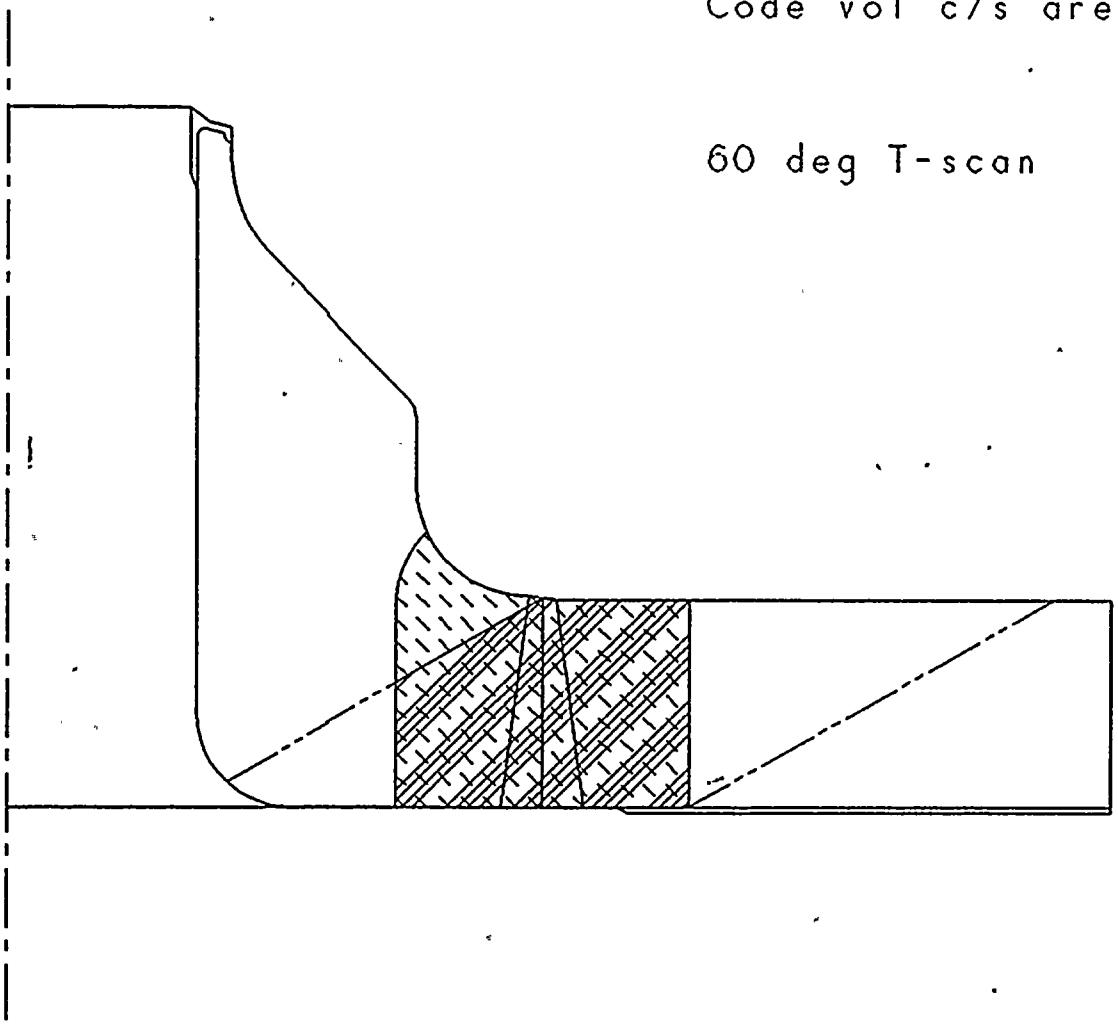
Code vol c/s area	64.3 in^2	
45 deg T-scan	50.1	77.9%



WNP-2 N6
RHR/LPCI

Code vol c/s area 64.3 in^2

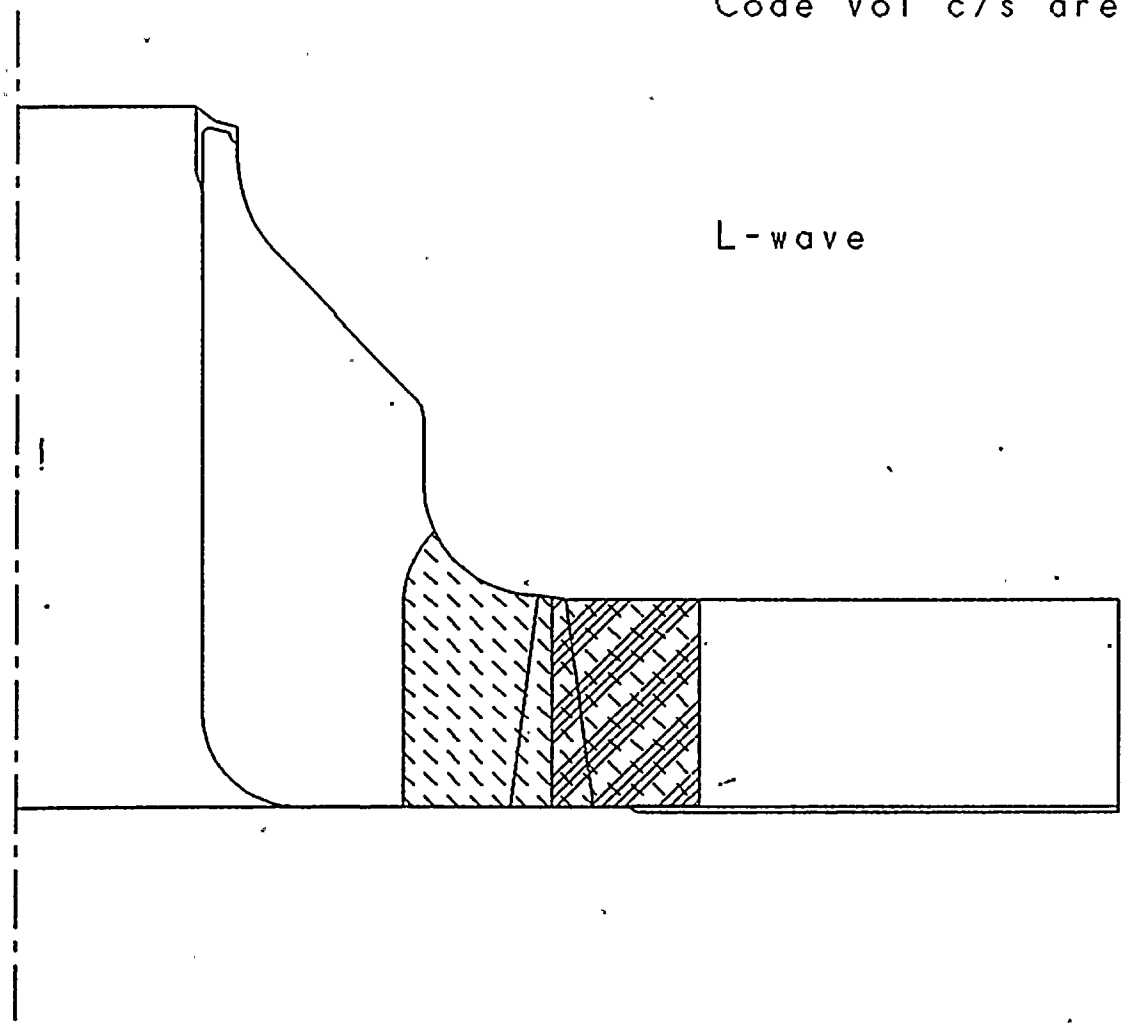
60 deg T-scan 54.6 · 84.9%



WNP-2 N6
RHR/LPCI

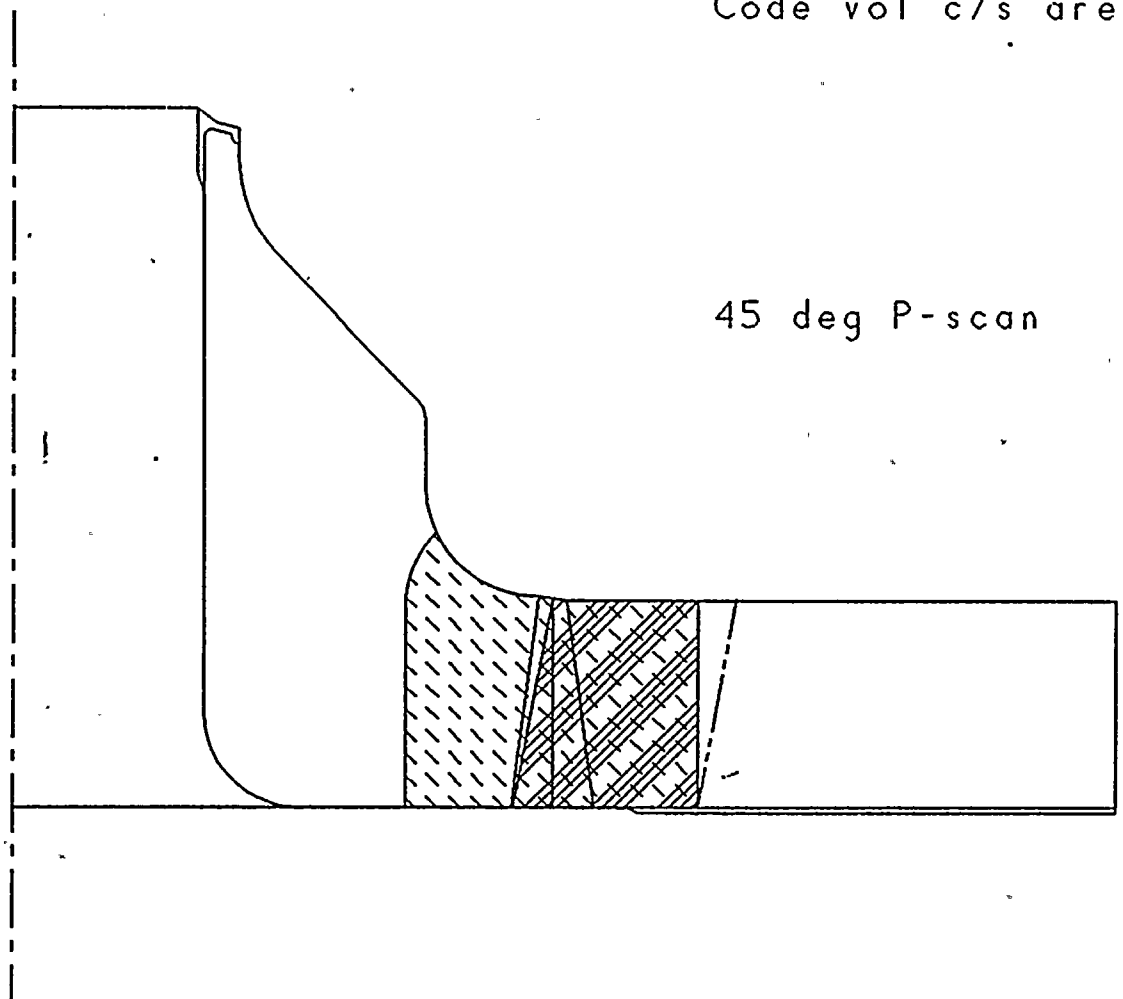
Code vol c/s area 64.3 in^2

L-wave	30.1	46.8%



WNP-2 N6
RHR/LPCI

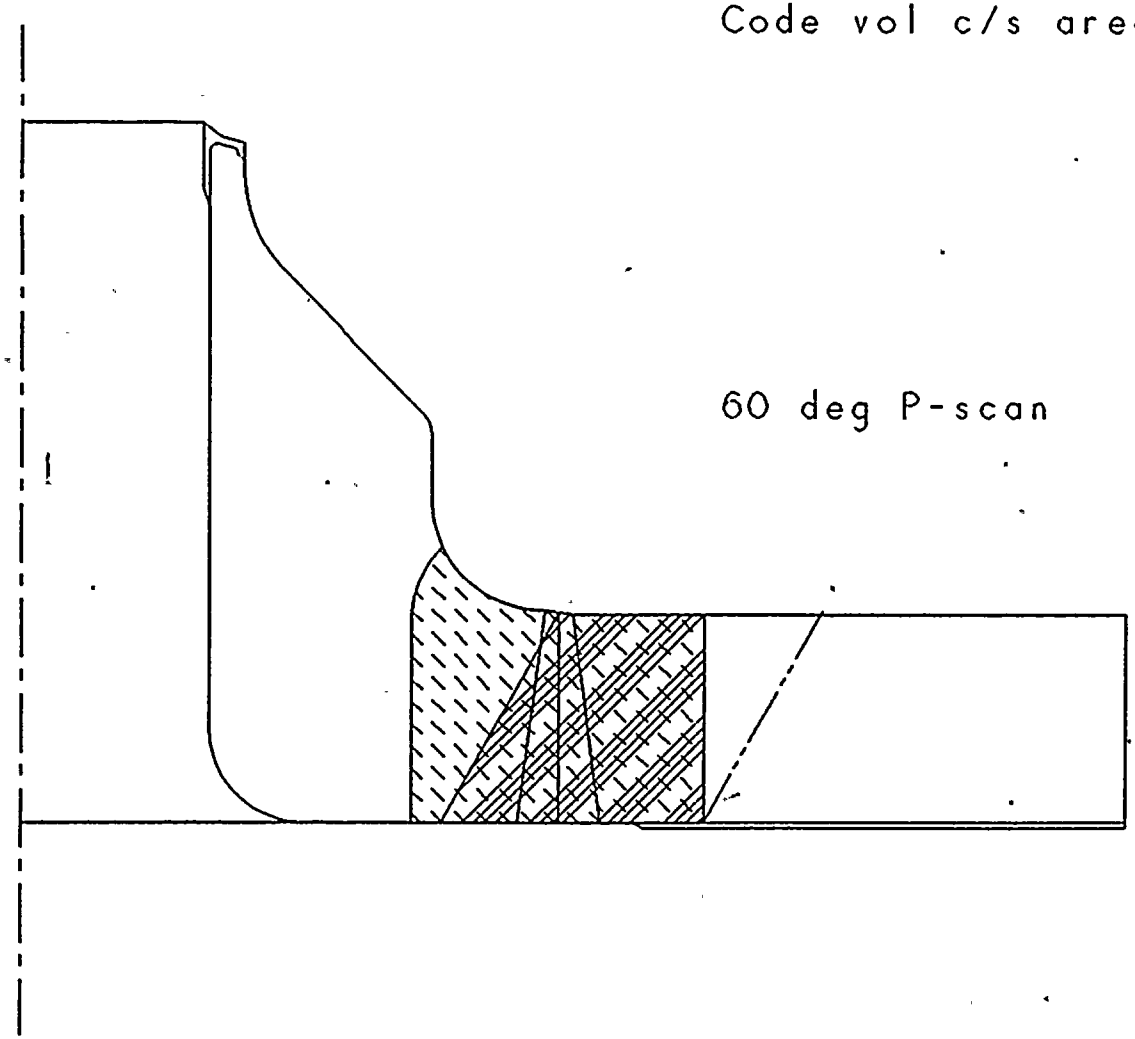
Code vol c/s area 64.3 in^2



45 deg P-scan	34.2	53.2%

WNP-2 N6
RHR/LPCI

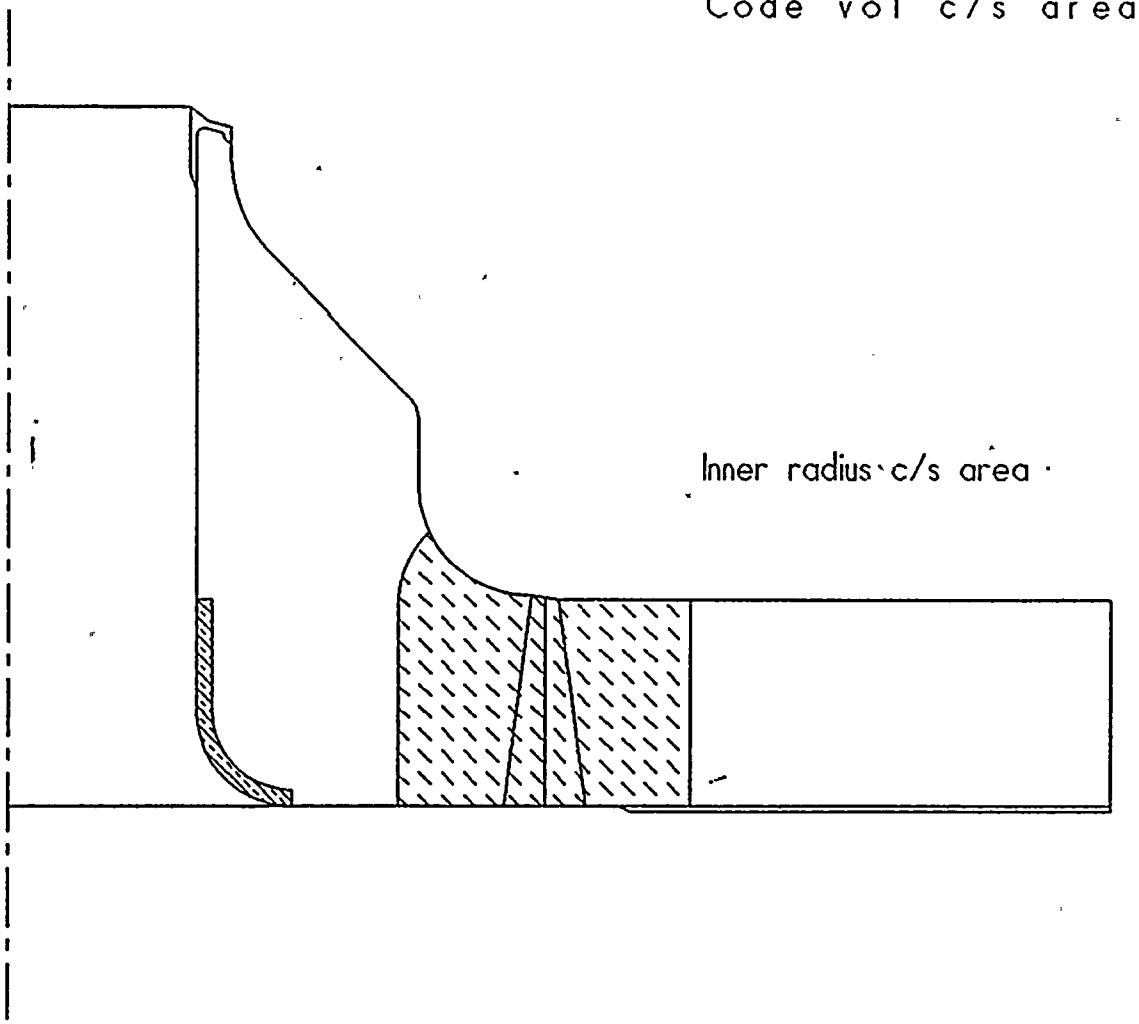
Code vol c/s area 64.3 in^2



60 deg P-scan	42.4	65.9%

WNP-2 N6
RHR/LPCI

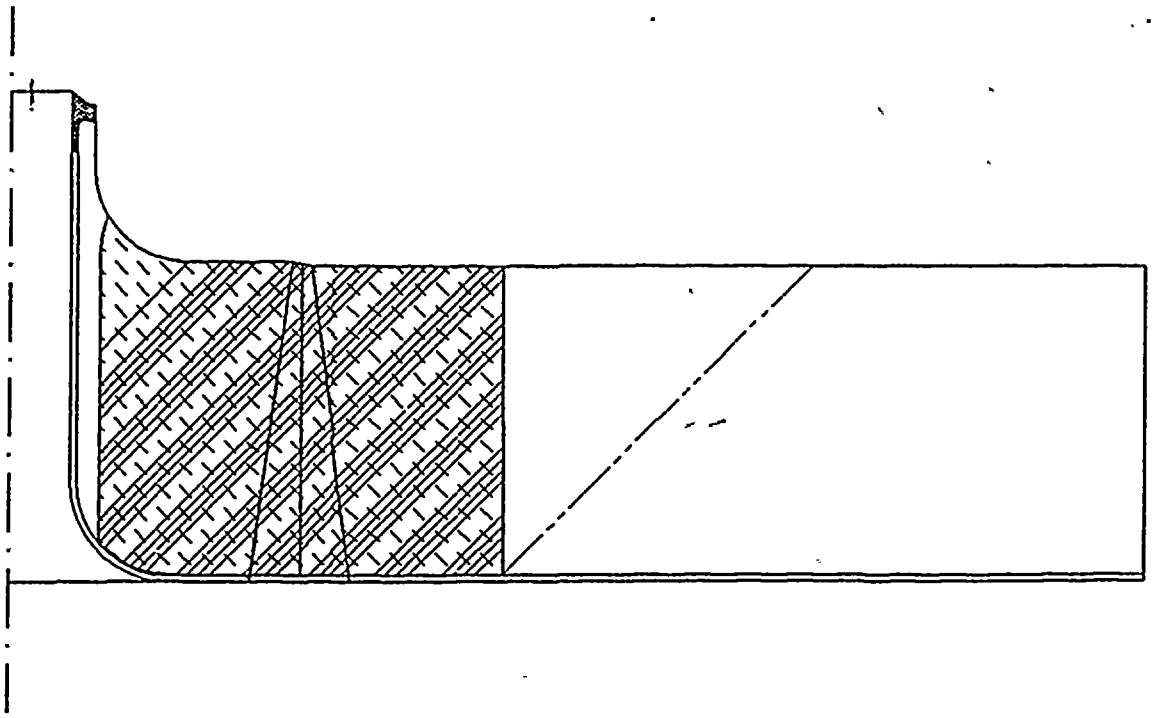
Code vol c/s area 64.3 in^2



Inner radius c/s area	4.0	100.0%

WNP-2 N9
Jet Pump Instrument

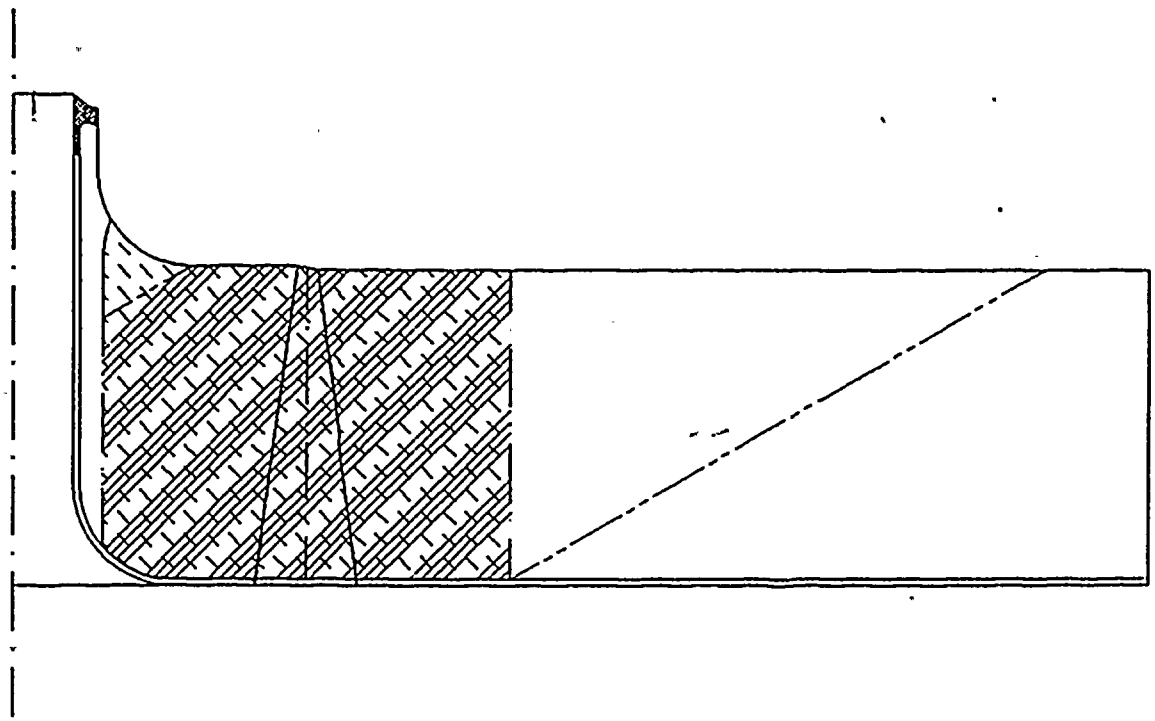
Code vol c/s area	127.5 in^2	
45 deg T-scan	122.0	95.7%



WNP-2 N9
Jet Pump Instrument

Code vol c/s area 127.5 in^2

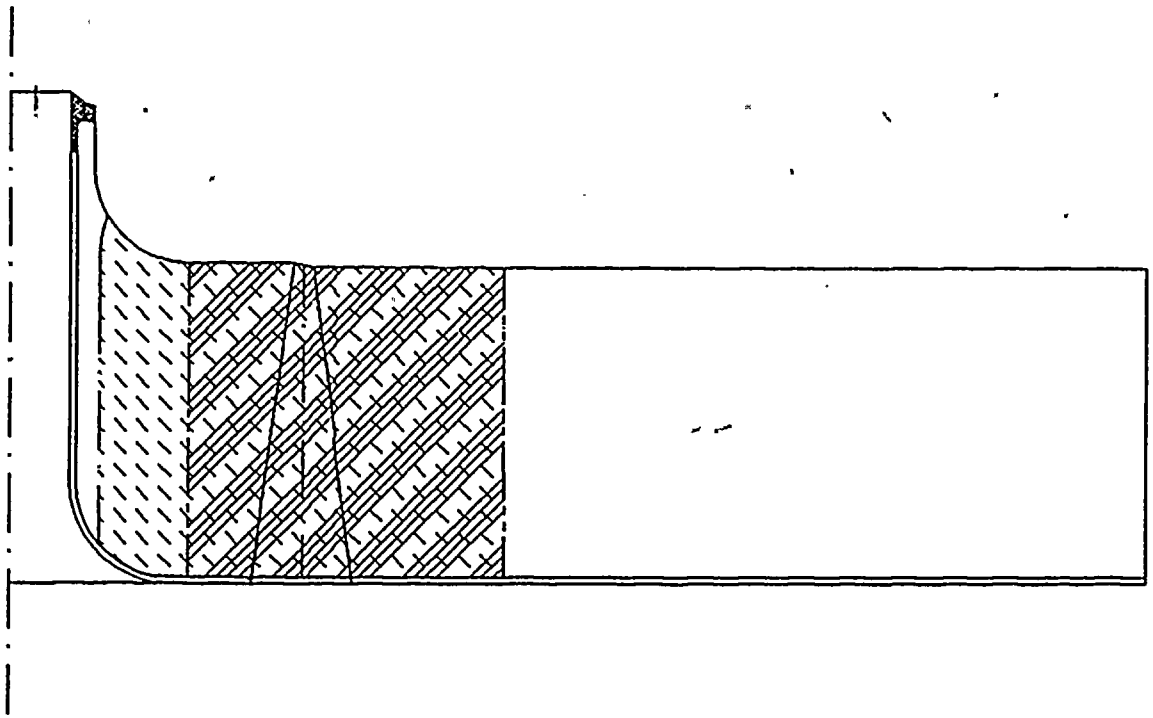
60 deg T-scan	124.0	97.3%



WNP-2 N9
Jet Pump Instrument

Code vol c/s area 127.5 in^2

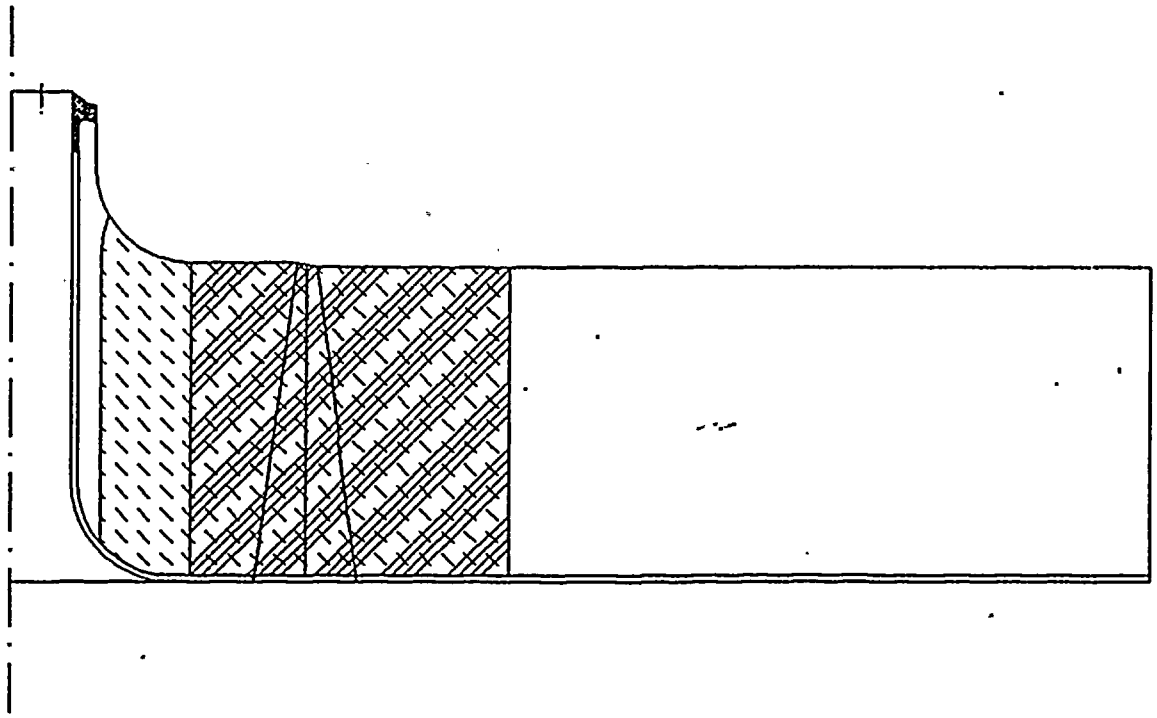
L-wave	98.8	77.5%



WNP-2 N9
Jet Pump Instrument

Code vol c/s area 127.5 in^2

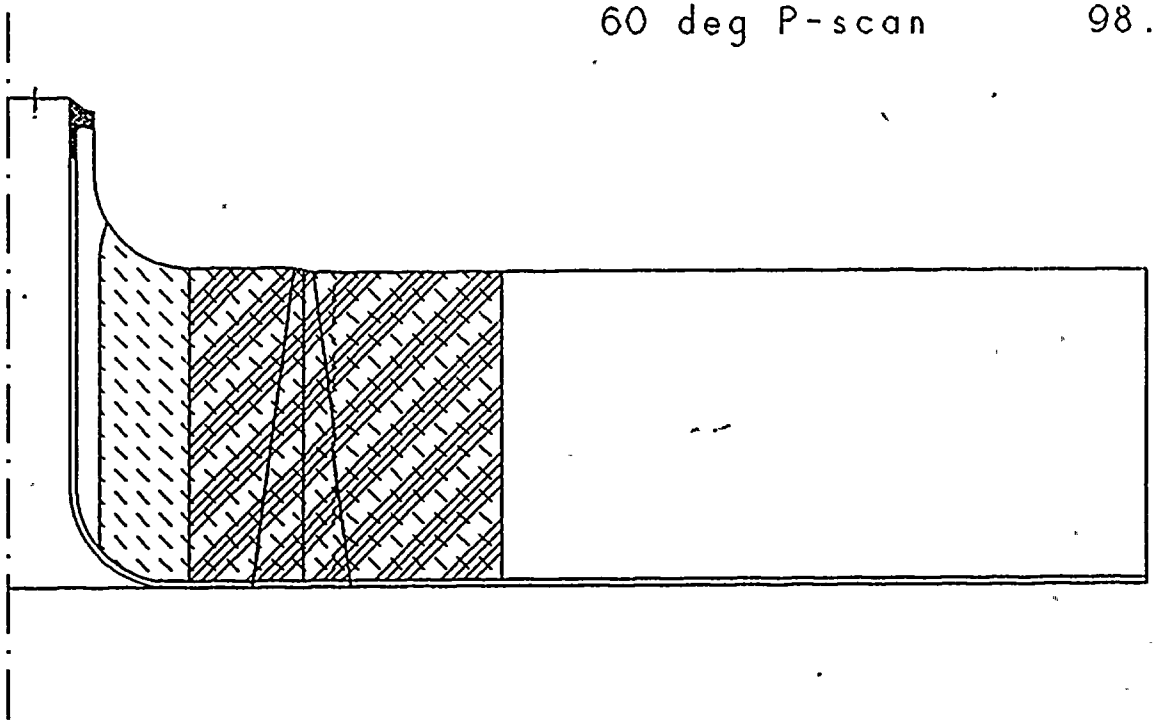
45 deg P-scan	98.8	77.5%



WNP-2 N9
Jet Pump Instrument

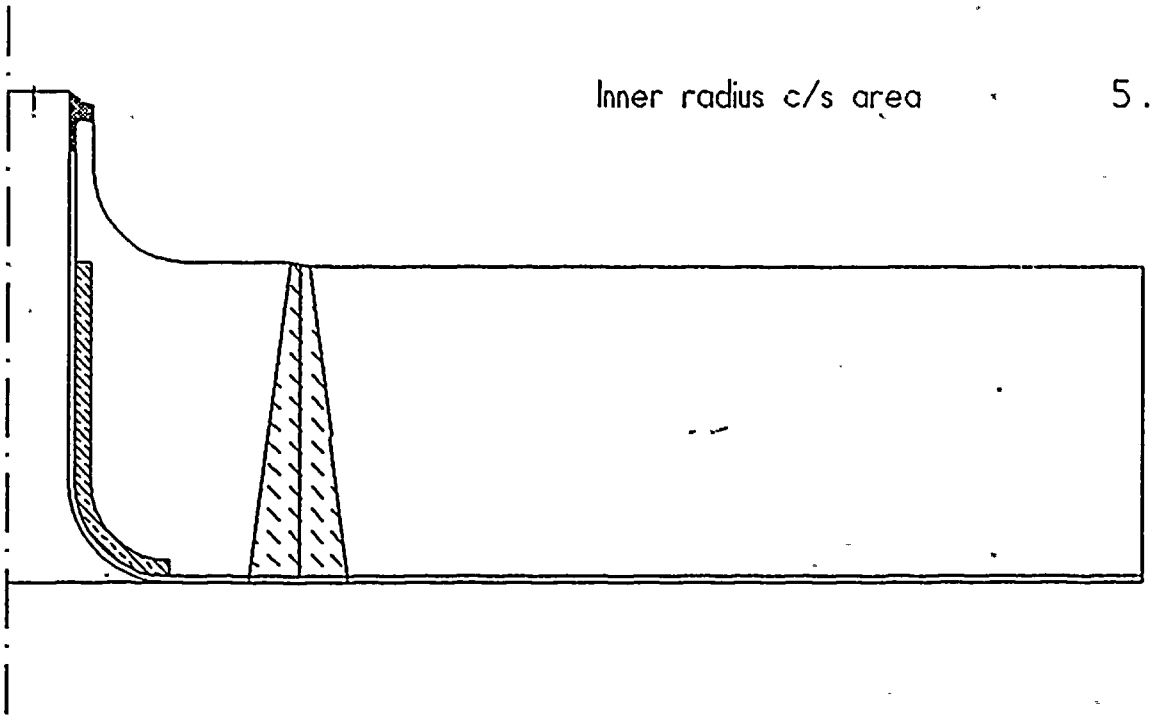
Code vol c/s area 127.5 in^2

60 deg P-scan	98.8	77.5%



WNP-2 N9
Jet Pump Instrument

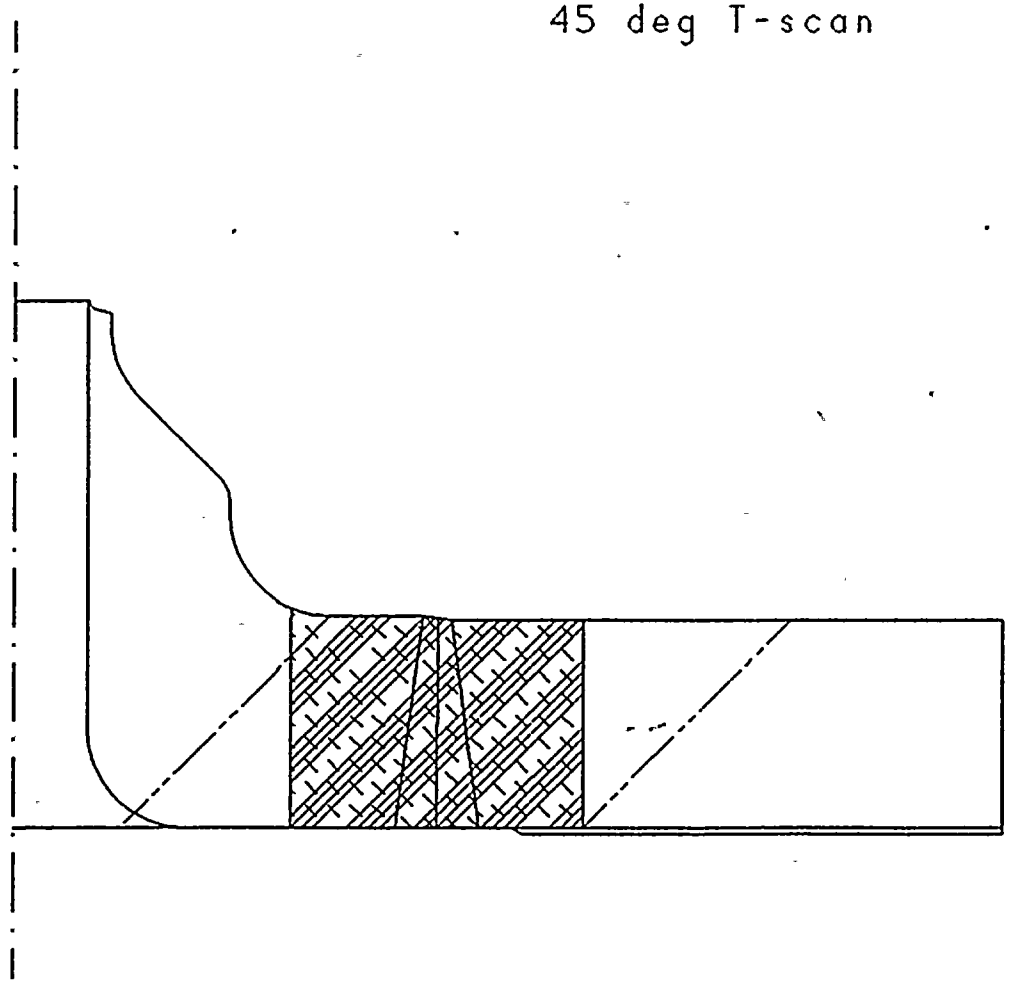
Code vol c/s area 127.5 in^2



Inner radius c/s area	5.6	100.0%

WNP-2 N10
CRD Hydraulic Return

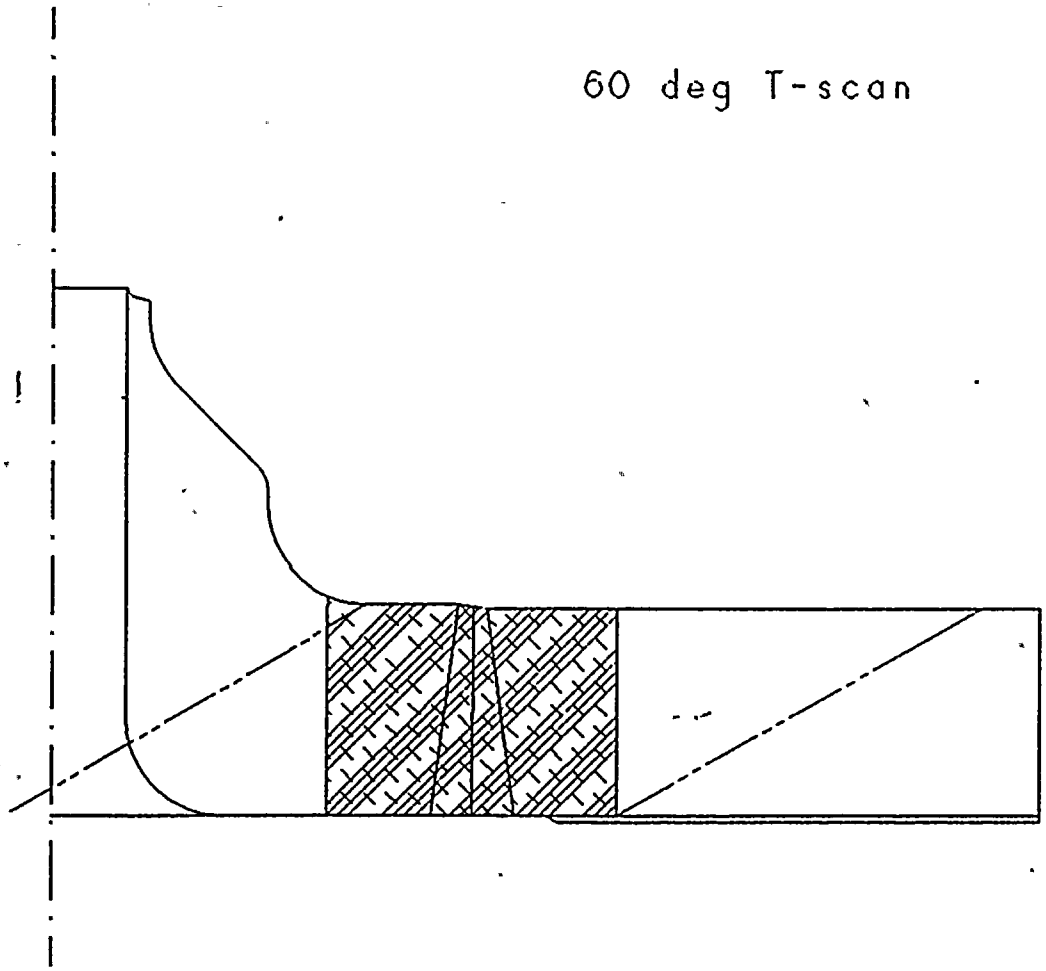
Code vol c/s area	61.1 in^2	
45 deg T-scan	60.2	98.5%



WNP-2 N10
CRD Hydraulic Return

Code vol c/s area 61.1 in^2

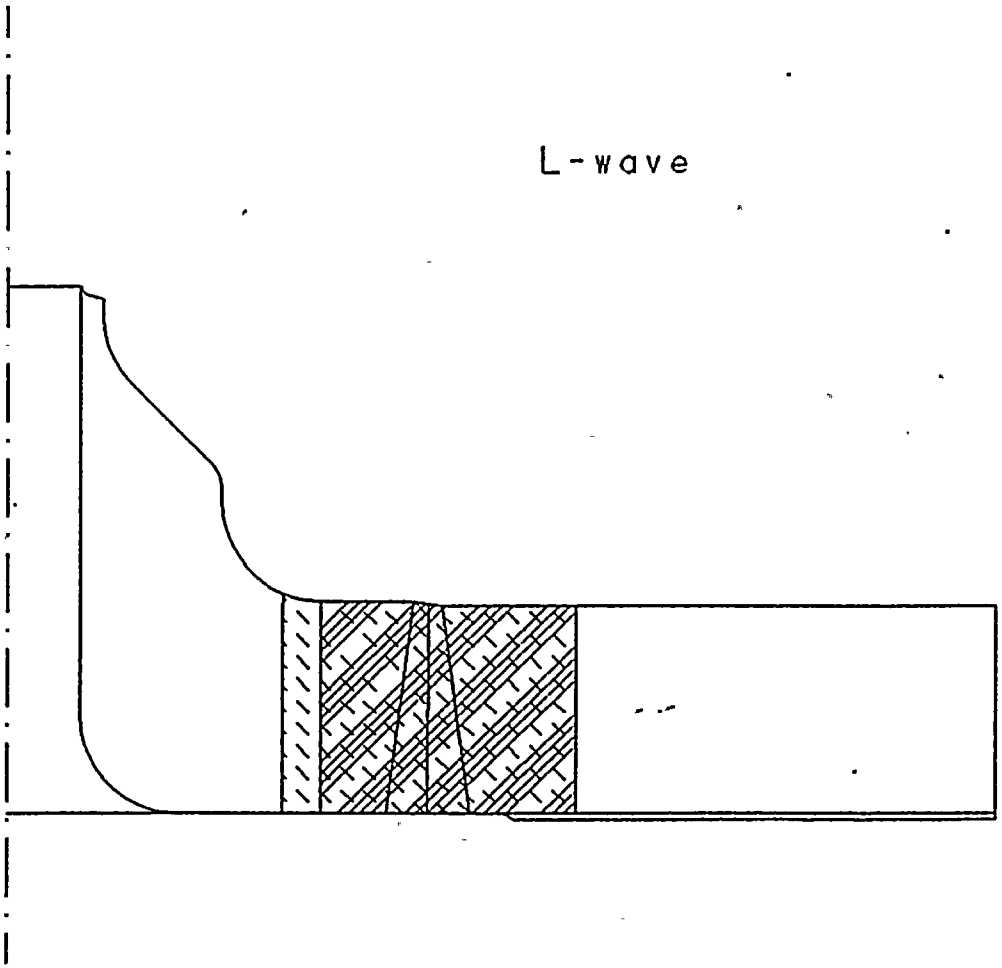
60 deg T-scan	60.5	99.0%



WNP-2 N1O
CRD Hydraulic Return

Code vol c/s area 61.1 in^2

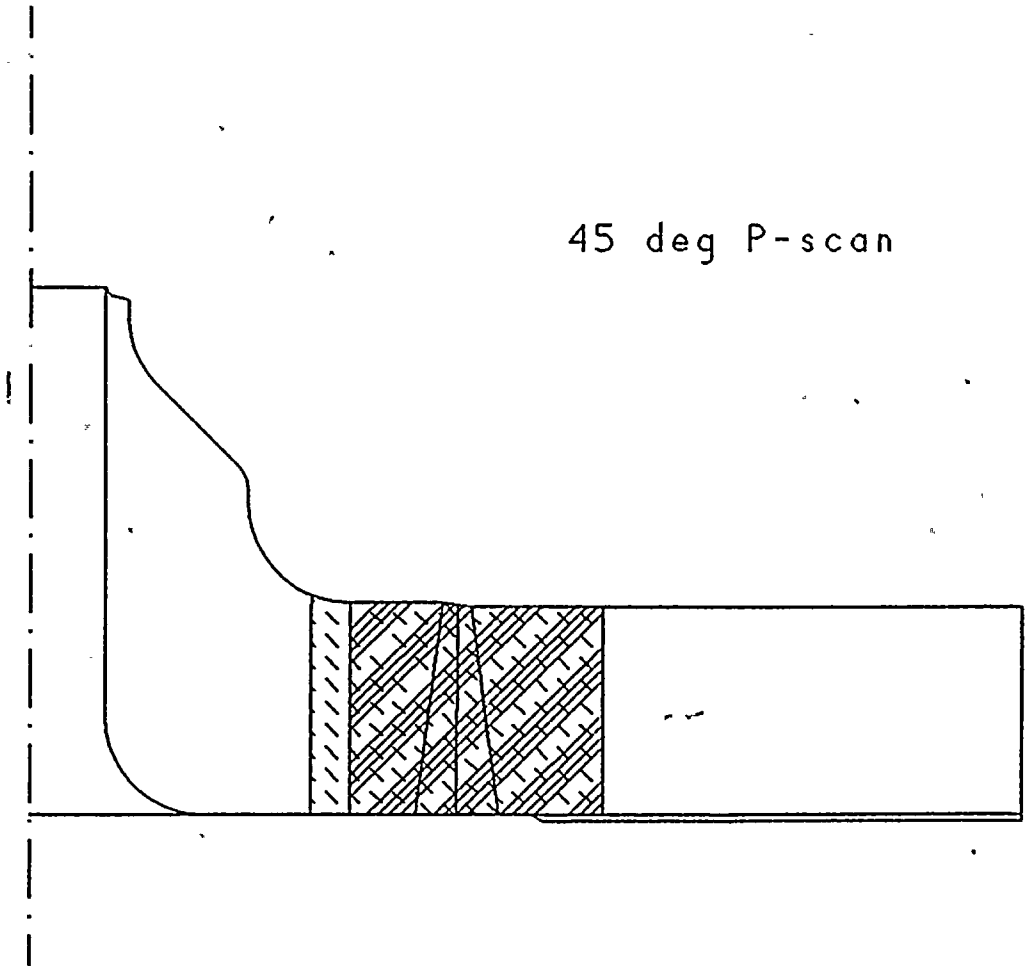
L-wave	52.6	86.1%



WNP-2 N10
CRD Hydraulic Return

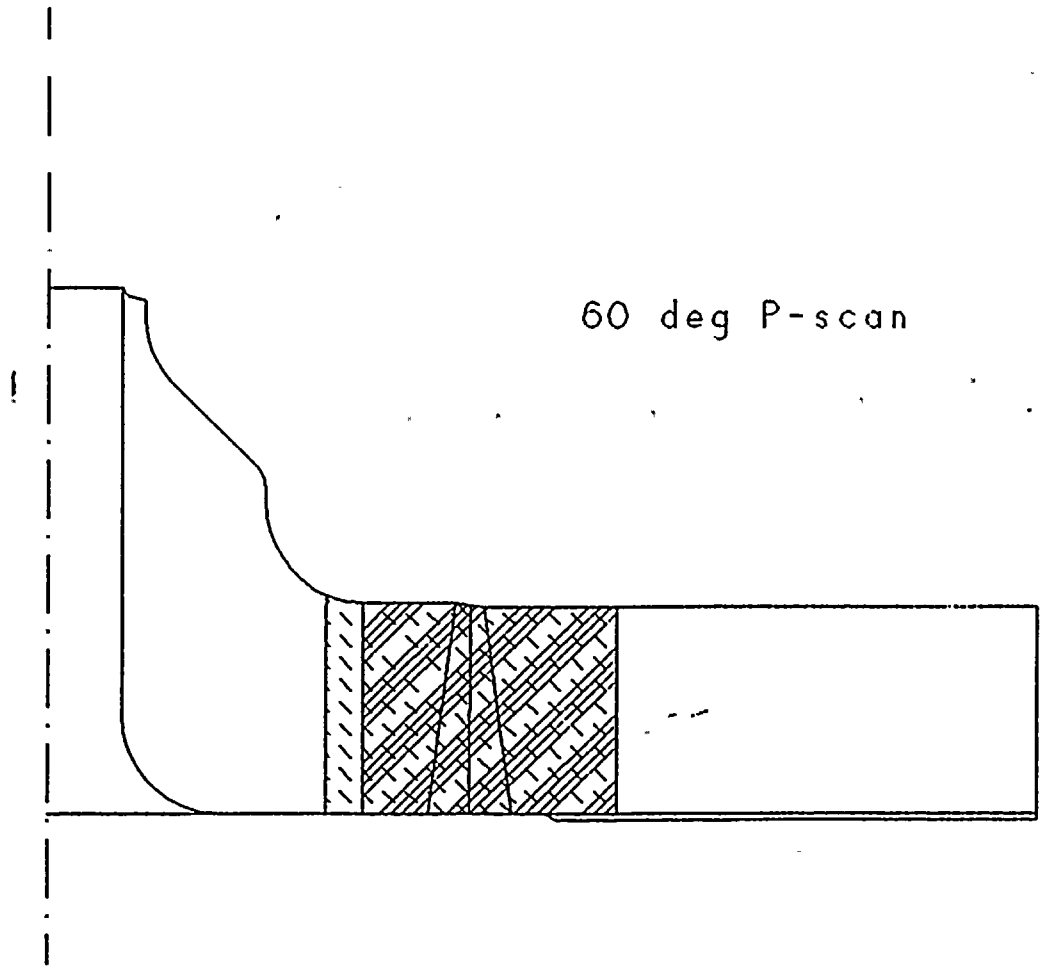
Code vol c/s area 61.1 in^2

45 deg P-scan 52.6 86.1%



WNP-2 N10
CRD Hydraulic Return

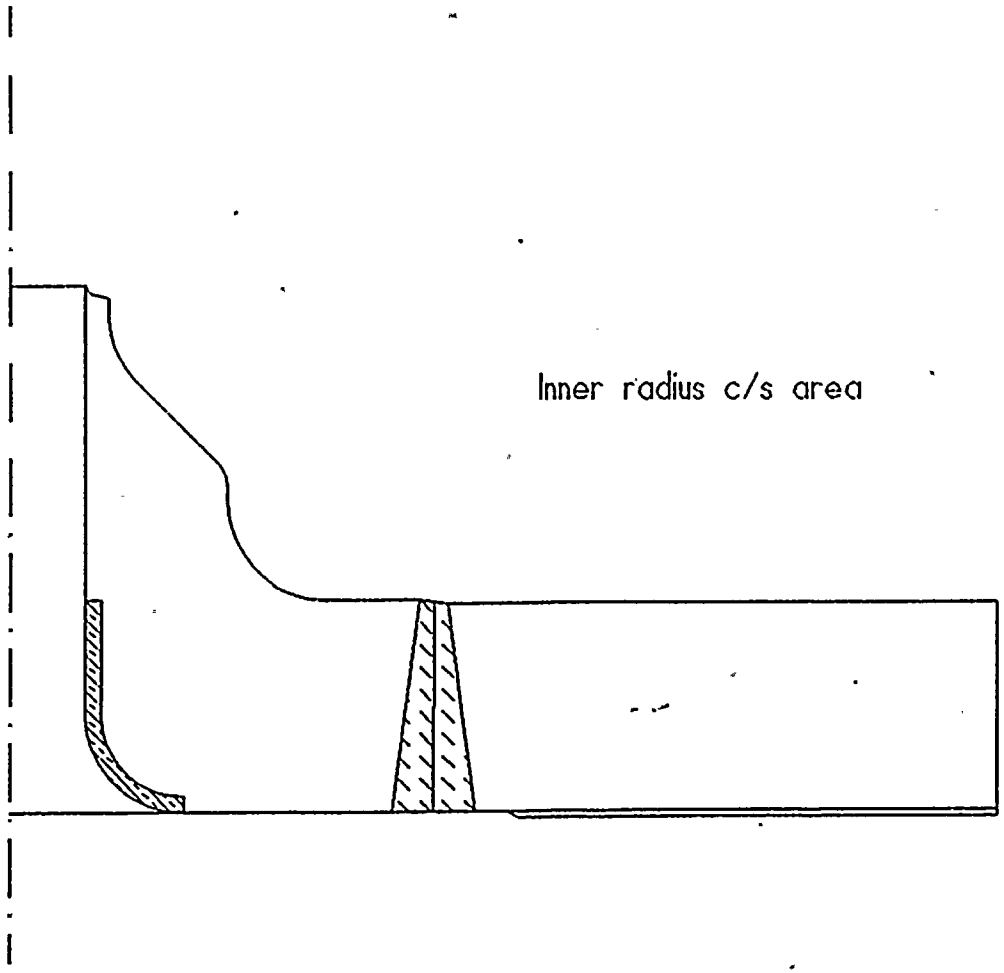
Code vol c/s area 61.1 in^2



60 deg P-scan 52.6 86.1%

WNP-2 N10
CRD Hydraulic Return

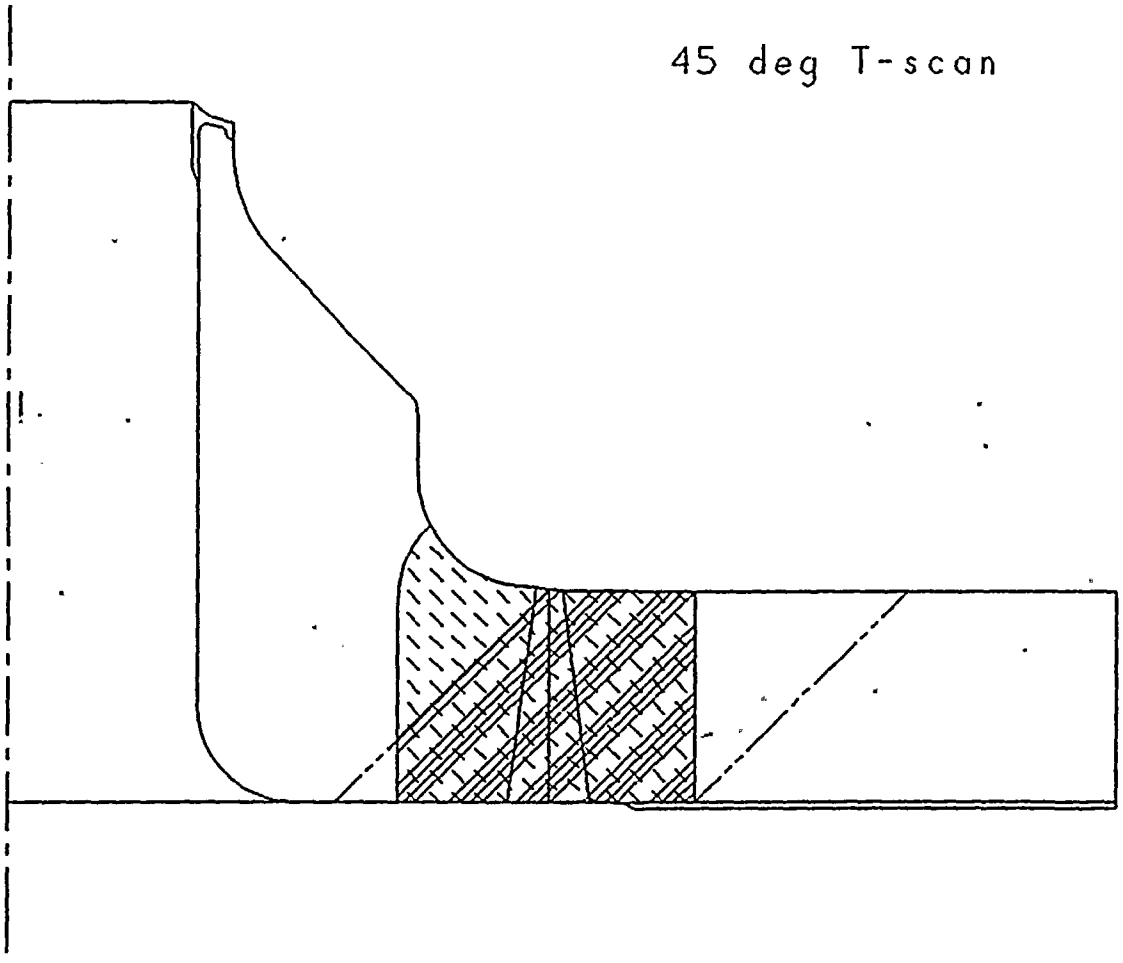
Code vol c/s area 61.1 in^2



Inner radius c/s area	4.0	100.0%

WNP-2 N16
Core Spray/HPCI

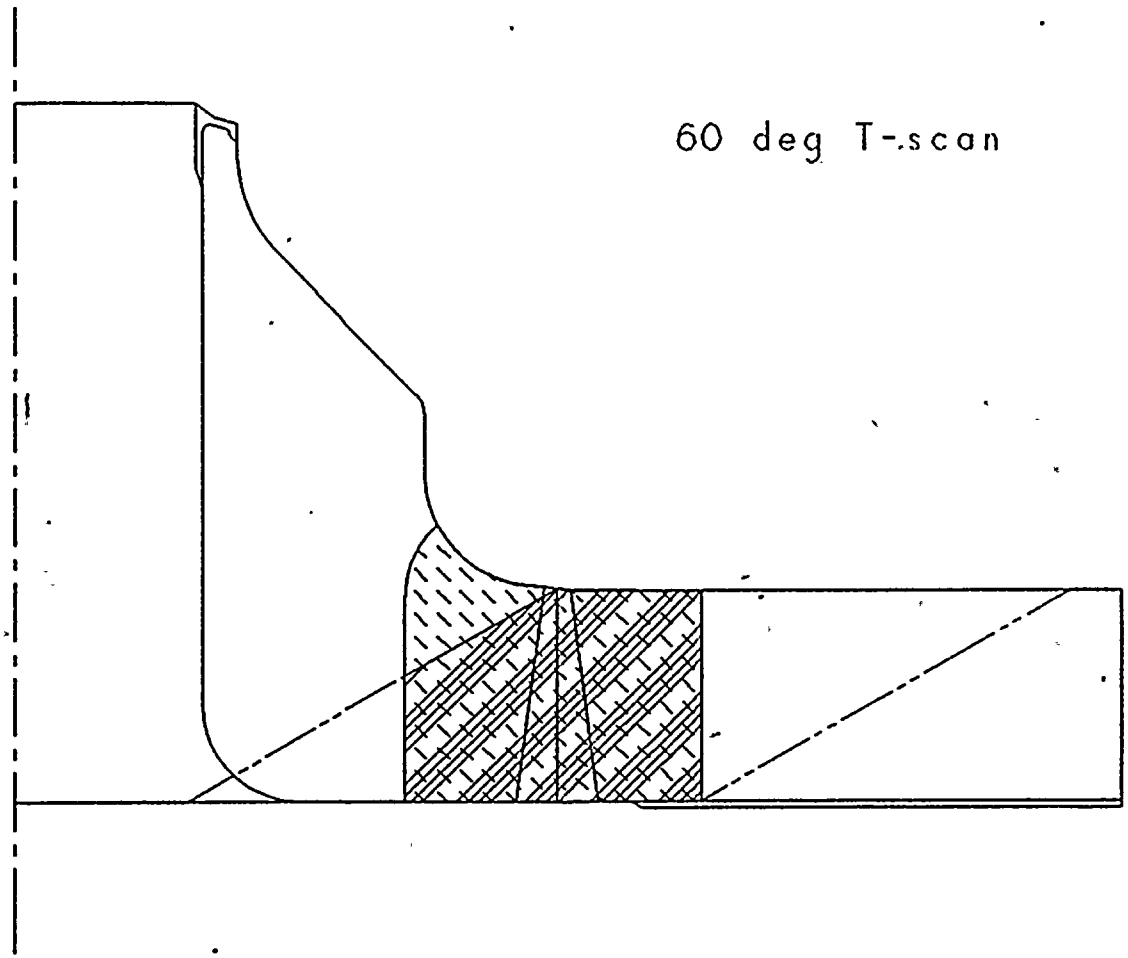
Code vol c/s area	66.2 in^2	
45 deg T-scan	51.5	77.8%



WNP-2 N16
Core Spray/HPCI

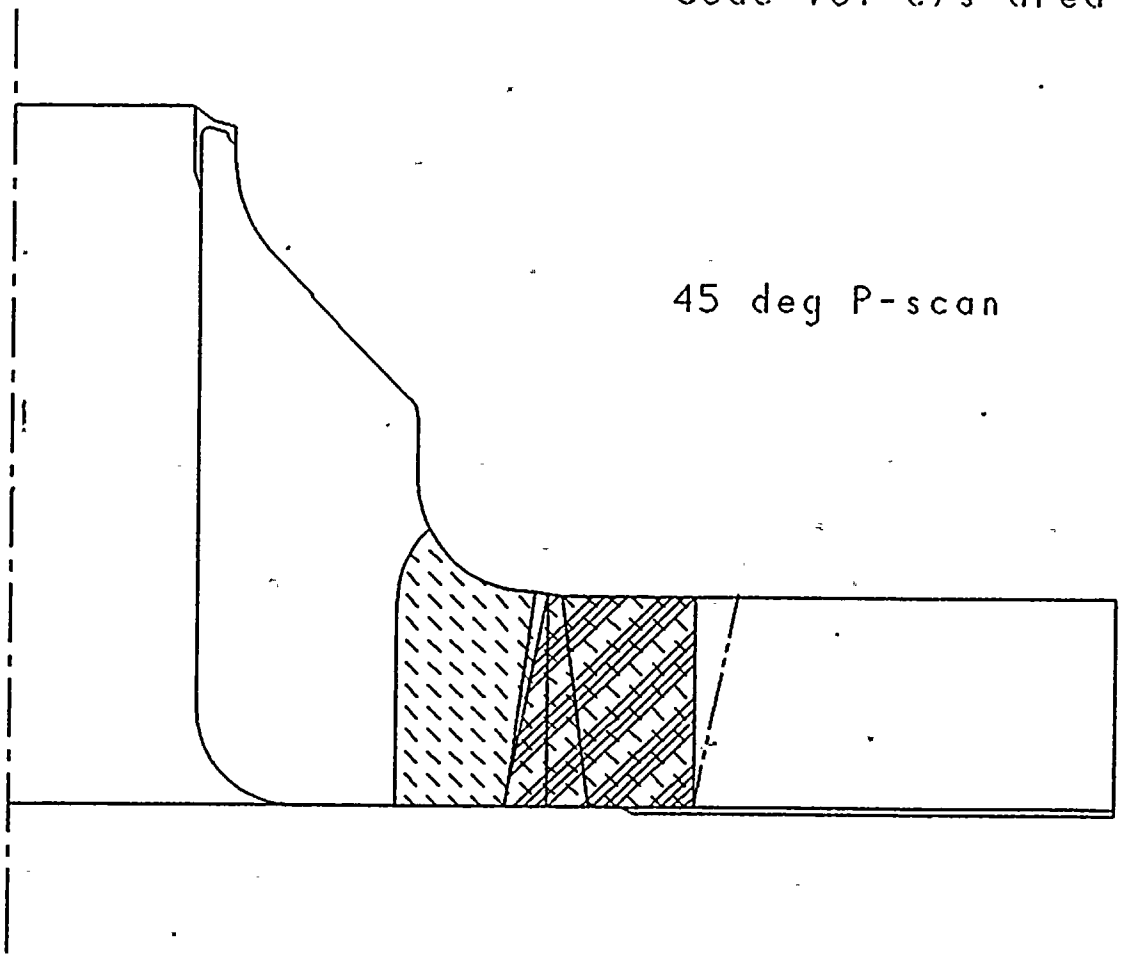
Code vol c/s area 66.2 in^2

60 deg T-scan	56.4	85.0%



WNP-2 N16
Core Spray/HPCI

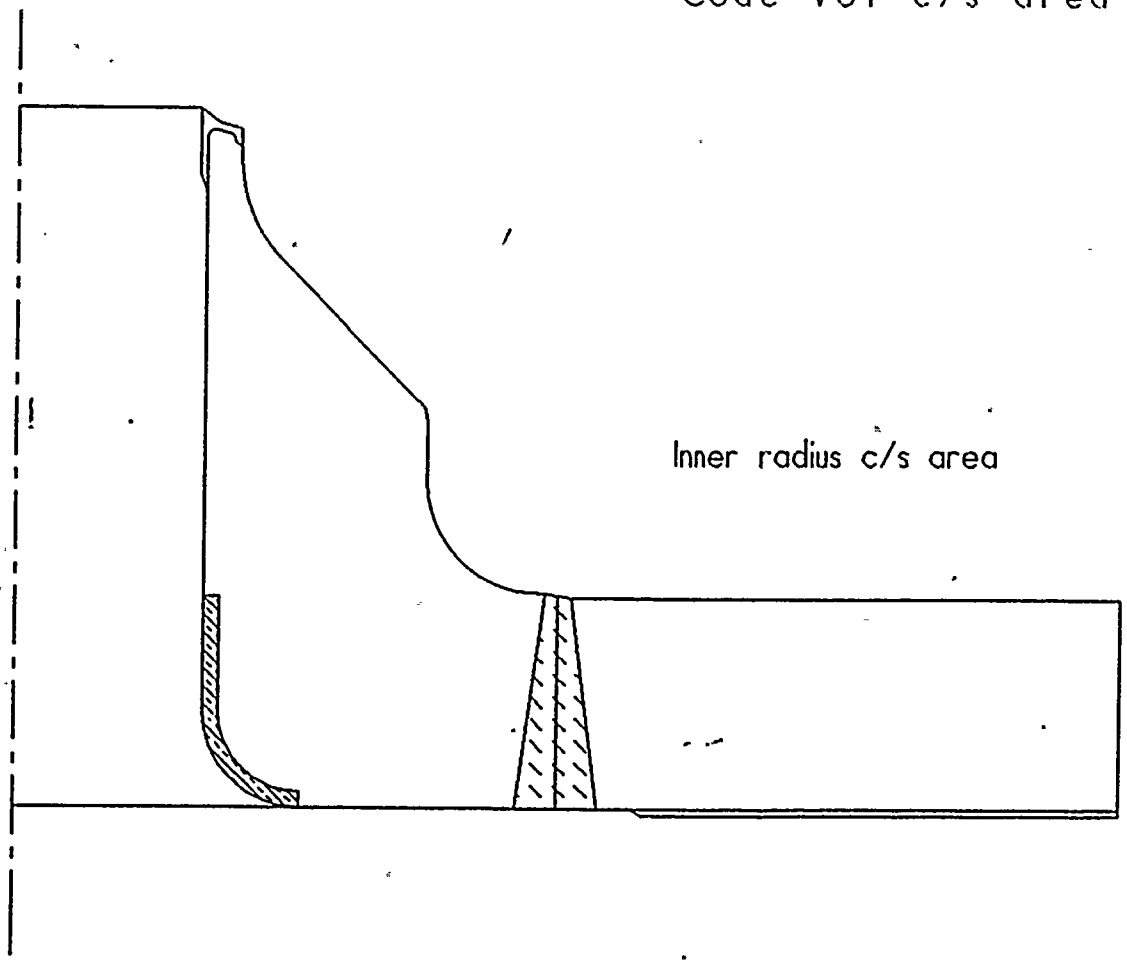
Code vol c/s area 66.2 in^2



45 deg P-scan	35.2	53.3%

WNP-2 N16
Core Spray/HPCI

Code vol c/s area 66.2 in^2



Inner radius c/s area	4.0	100.0%

COVERAGE PLOT FOR N3
NOZZLE TO VESSEL WELD
MAIN STEAM

N3

Main Steam

% Examined
45° = 86%
60° = 90%