Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

Ashok S. Bhatnagar
Vice President, Browns Ferry Nuclear Plant

June 2, 2003

10 CFR 50.55a

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of) Docket No. 50-260
Tennessee Valley Authority)

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 2 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI, INSERVICE INSPECTION (ISI) PROGRAM, THIRD TEN-YEAR INSPECTION INTERVAL - REQUESTS FOR RELIEF 2-ISI-18, AND 2-ISI-19

In accordance with 10 CFR 50.55a(g)(5), TVA is requesting relief from certain inservice inspection (ISI) requirements in Section XI of the ASME Boiler and Pressure Vessel Code. The need for these requests for relief was identified during ISI examinations recently completed during the BFN Unit 2, Cycle 12 refueling outage. The enclosures to this letter contain BFN Unit 2 requests for relief 2-ISI-18, and 2-ISI-19 for NRC review and approval.

TVA has determined that certain BFN Unit 2 welds had nondestructive examination (NDE) coverage limitations (less than 90 percent coverage completed) which exceed that specified in ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1."

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For 2-ISI-18, two austenitic stainless steel full penetration piping welds, one each for the Reactor Recirculation and Reactor Water Cleanup Systems, had calculated NDE examination coverage of 50 and 75 percent respectively. The limitations encountered during the performance of the ultrasonic (UT) examination were caused by component configuration. In addition, the welds are Category R-A (Westinghouse Owners Group (WOG) WCAP-14572, Revision 1-NP-A) Class 1 piping welds. These welds received greater than 90 percent examination coverage per the requirements of ASME Section XI. However, 10 CFR 50.55a(b)(2)(xv)(A)(2) restricts taking credit for "one-side" examinations without completing a single-sided ASME Section XI, Appendix VIII demonstration using flaws on the opposite side of the weld. At the time of the examinations, no Performance Demonstration Initiative Program existed for single-side austenitic welds. Consequently, the percent examination coverage achieved for the two welds was 50 and 75 percent respectively. Enclosure 1 provides BFN Unit 2 request for relief, 2-ISI-18, which addresses the two austenitic stainless steel piping welds examined during Cycle 12.

For 2-ISI-19, TVA has determined that 12 welds had nondestructive examination (NDE) coverage limitations (less than 90 percent coverage completed) which exceed that specified in ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." The components are Reactor Pressure Vessel (RPV) nozzles (ASME Section XI, Code Category B-D, Nozzle-To-Vessel Welds) which had calculated NDE examination coverage ranging between 45 and 89 percent completed. The limitations encountered during the performance of the ultrasonic (UT) examination were caused by component configuration. The nozzle contours limit the accessible UT examination volume. Hence, TVA is submitting BFN Unit 2 request for relief 2-ISI-19 in Enclosure 2.

TVA seeks review of these requests for relief by January 15, 2005, to support resource planning for the Unit 2, Cycle 13 (Spring 2005) refueling outage.

There are no new regulatory commitments in this letter. If you have any questions, please contact me at (256) 729-2636.

Sincerely,

Ashok S. Bhatnagar

Enclosures
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 2
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI,
INSERVICE INSPECTION (ISI) PROGRAM
(THIRD TEN-YEAR INSPECTION INTERVAL)

REQUESTS FOR RELIEF 2-ISI-18

(See Attached)

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 2
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI,
INSERVICE INSPECTION (ISI) PROGRAM
(THIRD TEN-YEAR INSPECTION INTERVAL)

REQUESTS FOR RELIEF 2-ISI-18

Executive Summary: This request for relief addresses one Reactor Recirculation System and one Reactor Water Cleanup System Full Penetration Piping Welds examined during Cycle 12 in the first period of the Third Ten-Year ISI interval.

The subject welds were examined with the latest ultrasonic techniques, procedures, equipment, and personnel qualified to the requirements of the Performance Demonstration Initiative (PDI) Program, as mandated by 10 CFR 50.55a(g)(4).

An ultrasonic examination was performed on these piping welds of accessible areas to the maximum extent practical due to the configuration. Credit for the one-sided only ultrasonic examination provided 50 percent coverage for weld KR-2-25 and 75 percent coverage for weld RWCU-2-003-G003, because of the requirement mandated in 10 CFR 50.55a(b)(2)(xv)(A)(2), which states in part, "Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaw on the opposite side of the weld." At this time, there is no Appendix VIII Program for single sided austenitic welds nor is one planned in the future, therefore only 50 percent coverage can be claimed on weld KR-2-25 and 75 percent coverage on weld RWCU-2-003-G003. Under the original ASME Section XI Code requirements, UT coverage attained was 100 percent.

The performance of the ultrasonic examination of the subject areas to the maximum extent practical provides an acceptable level of

	quality and safety because the information and data obtained from the volume examined provides sufficient information to judge the overall integrity of the piping welds. Therefore, pursuant to 10 CFR 50.55a(g)(5)(iii), it is requested that relief be granted for the third inspection interval.
Unit:	Two (2)
ISI Interval:	ASME Section XI, Third Ten-Year ISI Inspection Interval (May 25, 2001 to May 24, 2011)
Systems:	Reactor Recirculation System (RECIRC) Reactor Water Cleanup System (RWCU)
Components:	2 Full Penetration Piping Welds
ASME Code Class:	ASME Code Class 1
ASME Section XI Code Edition:	1995 Edition, 1996 Addenda
Code Table:	Westinghouse Owners Group (WOG) Topical Report WCAP-14572, Revision 1-NP-A, Table 4.1-1 (Note: Table 4.1-1 in WCAP-14572, Revision 1-NP-A is identical to Table 1 in Code Case N-577)
Examination Category:	R-A, Risk-Informed Piping Examinations
Examination Item Number:	R1.16, Elements Subject to Intergranular Stress Corrosion Cracking (IGSCC)
Code Requirement:	WCAP-14572, Revision 1-NP-A, Table 4.1-1, Examination Category R1.16, requires volumetric examination of 100 percent of the weld and adjacent base material as depicted in ASME Section XI Code, Figure IWB-2500-8(c).

(Note: Table 4.1-1 in WCAP-14572, Revision 1-NP-A is identical to Table 1 in Code Case N-577)

Code Requirement From Which Relief Is Requested:

Relief is requested from the Risk-Informed Inservice Inspection Program, WCAP-14572, Revision 1-NP-A, Table 4.1-1, Examination Category R-A, Item No. R1.16) to perform essentially 100 percent volumetric examination of weld and adjacent base material.

List Of Items Associated With The Relief Request:

Weld KR-2-25 - Pipe to Tee

Weld RWCU-2-003-G003 - Pipe to Flued Head

Basis for Relief:

It is not possible to perform the volumetric ultrasonic examination from both sides of the welds due to the configuration of these components. Also, because of the requirement mandated in 10 CFR 50.55a(b)(2)(xv)(A)(2), which states in part, "Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaw on the opposite side of the weld." At this time, there are no Appendix VIII Program for single-sided austenitic welds nor is one planned in the future, therefore, only 50 percent coverage for weld KR-2-25 and 75 percent coverage for weld RWCU-2-003-G003 can be claimed.

Under the original ASME Section XI Code requirements UT coverage attained was 100 percent.

Weld KR-2-25 limitations were due the configuration of the component, Pipe to Tee.

Weld RWCU-2-003-G003 limitations were due to the configuration of the component, Pipe to Flued Head.

The performance of the ultrasonic examination of the subject areas to the maximum extent practical provides an acceptable level of quality and safety because the information and data obtained from the volume examined provides sufficient information to judge the overall integrity of the piping welds. Attached is a detailed description of the limitations in Table 1.

Alternative Examination:

None. In lieu of the Code required essentially 100 percent volume ultrasonic examination, TVA proposes an ultrasonic examination of accessible areas to the maximum extent practical given the component design configuration of the aforementioned piping welds.

Justification For The Granting of Relief:

The welds were examined with the latest ultrasonic techniques, procedures, equipment, and personnel qualified to the requirements of the Performance Demonstration Initiative (PDI) Program, as mandated by 10 CFR 50.55a(g)(4).

An ultrasonic examination was performed on the piping welds to accessible areas to the maximum extent practical due to the configuration. Credit for the one-sided only ultrasonic examination provided 50 percent coverage on weld KR-2-25 and 75 percent coverage on weld RWCU-2-003-G003, because of the requirement mandated in 10 CFR 50.55a(b)(2)(xv)(A)(2), which states in part, "Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaw on the opposite side of the weld." At this time, there is no Appendix VIII Program for single sided austenitic welds nor is one planned in the future, therefore only 50 percent coverage on weld KR-2-25 and 75 percent coverage on weld RWCU-2-003-G003 can be claimed. Under the original ASME Section XI Code requirements, UT coverage attained was 100 percent.

Weld KR-2-25 limitations were due the configuration of the component, Pipe to Tee.

Weld RWCU-2-003-G003 limitations were due to the configuration of the component, Pipe to Flued Head.

The performance of the ultrasonic examination of the subject areas to the maximum extent practical provides an acceptable level of quality and safety because the information and data obtained from the volume examined provides sufficient information to judge the overall integrity of the piping welds.

Therefore, pursuant to 10 CFR 50.55a(g)(5)(iii), TVA requests that relief be granted for the third Ten-Year ISI inspection interval.

Implementation Schedule:

This request for relief is applicable to the Third Ten-Year inspection interval for BFN Unit 2 (May 25, 2001 to May 24, 2011).

The Reactor Recirculation System and Reactor Water Cleanup System piping welds listed in Table 1 were examined during the first period (Cycle 12) of the Third Ten-Year inspection interval.

References:

Attachment - 2 ISI Sketches

- 2-ISI-0270-C, Sheet 2
- 2-ISI-0272-C, Sheet 1

TABLE 1

WELD NUMBERS	NPS	ISI DRAWING	PERCENT EXAMINED	REMARKS
KR-2-25	28"	2-ISI-0270-C	50%	Limitations due to component configuration and the requirement in 10 CFR 50.55a(b)(2)(xv)(A)(2), which requires UT of one-side of austenitic welds to be qualified to Appendix VIII Program to claim full code coverage. At this time, there are no Appendix VIII Program for single sided austenitic welds nor is one planned for the future, therefore only 50 percent coverage can be claimed.
RWCU-2-003-G003	6"	2-ISI-0272-C	75%	Limitations due to component configuration and the requirement in 10 CFR 50.55a(b)(2)(xv)(A)(2), which requires UT of one-side of austenitic welds to be qualified to Appendix VIII Program to claim full code coverage. At this time, there are no Appendix VIII Program for single sided austenitic welds nor is one planned for the future, therefore only 75 percent coverage can be claimed.

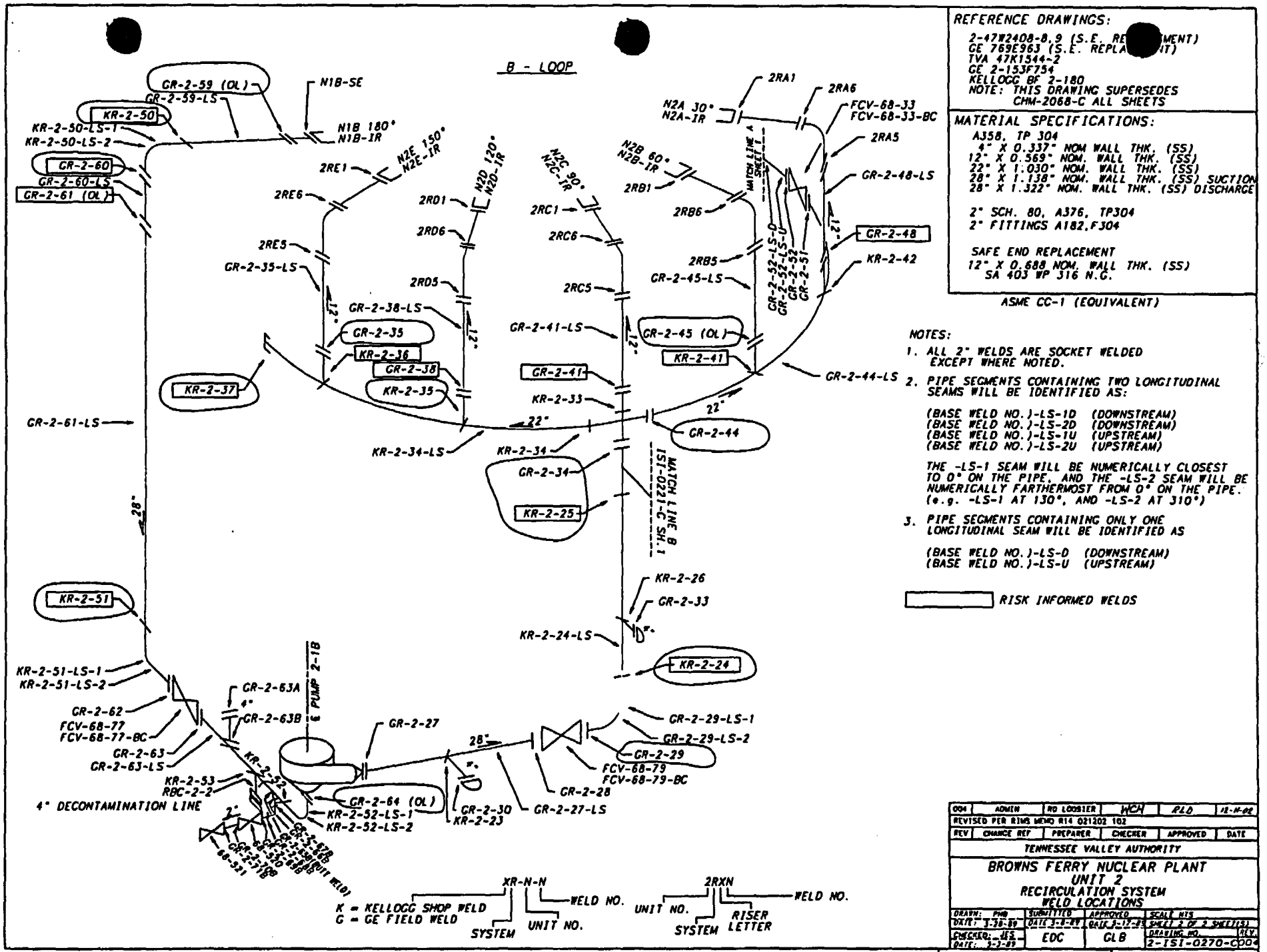
Attachment

2-ISI-18

Two (2) Sketches

2-ISI-0270-C, Sheet 2, Recirculation System Weld Locations

2-ISI-0272-C, Sheet 1, Reactor Water Cleanup, RCIC, and CRD Weld Identification



REFERENCE DRAWINGS:

2-47W2408-8,9 (S.E. RE[illegible]MENT)
GE 769E963 (S.E. REPLA[illegible]IT)
TVA 47K1544-2
GE 2-153F754
KELLOGG BF 2-180
NOTE: THIS DRAWING SUPERSEDES CHM-2068-C ALL SHEETS

MATERIAL SPECIFICATIONS:

A358, TP 304
4" X 0.337" NOM WALL THK. (SS)
12" X 0.569" NOM. WALL THK. (SS)
22" X 1.030" NOM. WALL THK. (SS)
28" X 1.138" NOM. WALL THK. (SS) SUCTION
28" X 1.322" NOM. WALL THK. (SS) DISCHARGE

2" SCH. 80, A376, TP304
2" FITTINGS A182, F304

SAFE END REPLACEMENT
12" X 0.688 NOM. WALL THK. (SS)
SA 403 WP 316 N.G.

ASME CC-1 (EQUIVALENT)

NOTES:

1. ALL 2" WELDS ARE SOCKET WELDED EXCEPT WHERE NOTED.
2. PIPE SEGMENTS CONTAINING TWO LONGITUDINAL SEAMS WILL BE IDENTIFIED AS:

   (BASE WELD NO.)-LS-1D (DOWNSTREAM)
   (BASE WELD NO.)-LS-2D (DOWNSTREAM)
   (BASE WELD NO.)-LS-1U (UPSTREAM)
   (BASE WELD NO.)-LS-2U (UPSTREAM)

   THE -LS-1 SEAM WILL BE NUMERICALLY CLOSEST TO 0° ON THE PIPE, AND THE -LS-2 SEAM WILL BE NUMERICALLY FARTHERMOST FROM 0° ON THE PIPE. (e.g. -LS-1 AT 130°, AND -LS-2 AT 310°)

3. PIPE SEGMENTS CONTAINING ONLY ONE LONGITUDINAL SEAM WILL BE IDENTIFIED AS

   (BASE WELD NO.)-LS-D (DOWNSTREAM)
   (BASE WELD NO.)-LS-U (UPSTREAM)

[ ] RISK INFORMED WELDS

004	ADMIN	RO LOOBIER	WCH	RLD	12-M-00
REVISED PER RIMS MEMO R14 021202 102					
REV	CHANGE REF	PREPARER	CHECKER	APPROVED	DATE

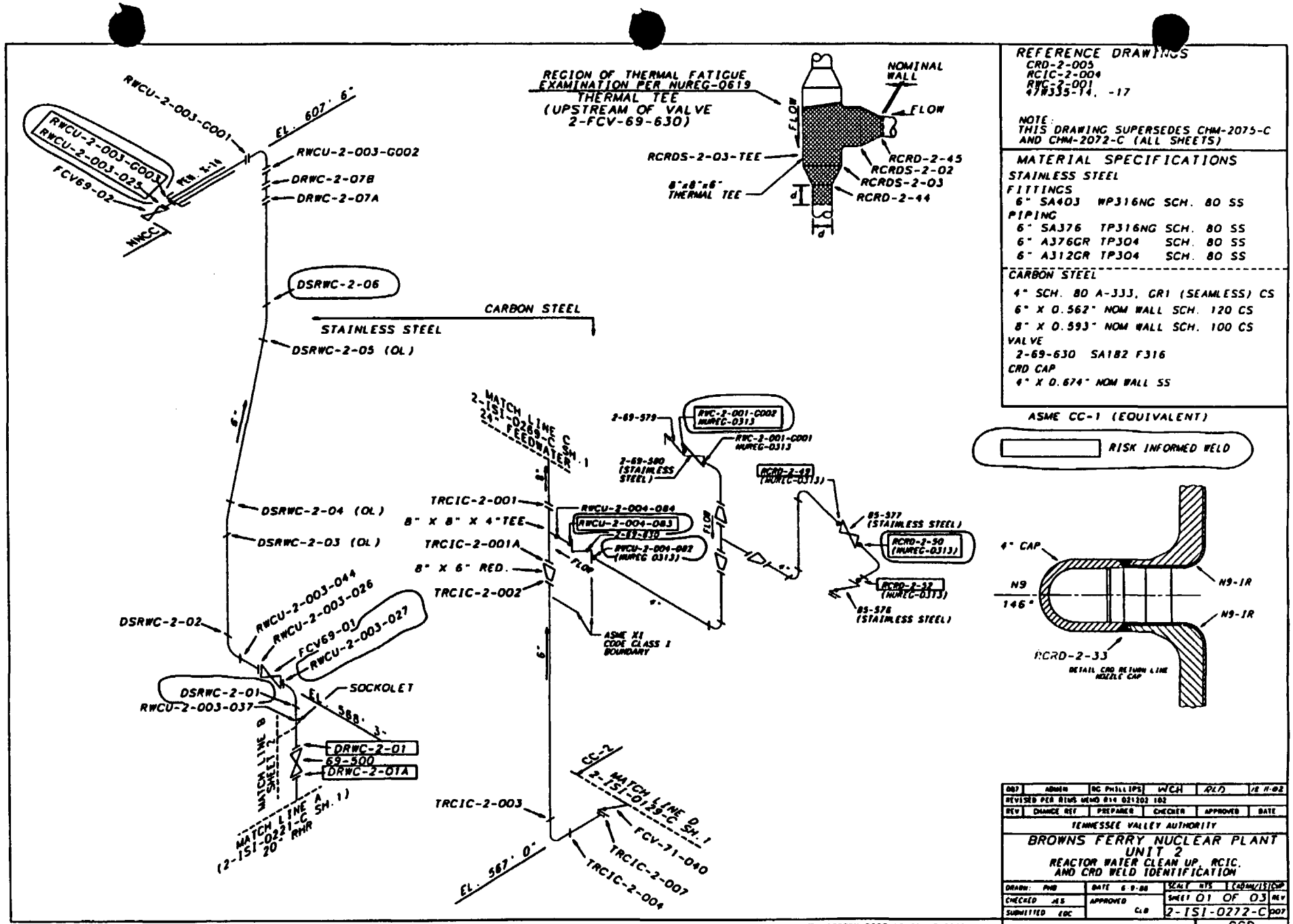
TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT
UNIT 2
RECIRCULATION SYSTEM
WELD LOCATIONS

DRAWN: PMD	SUBMITTED	APPROVED	SCALE NTS
DATE: 3-28-89	DATE 3-8-89	DATE 3-17-89	SHEET 2 OF 2 SHEET(S)
CHECKED: JES	EDC	GLB	DRAWING NO. 2-ISI-0270-C004 REV.
DATE: 3-3-89			

ALL A/D HISTORY RESEARCHED @ R000

CCD



2-ISI-0272-C, Sheet 1

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 2
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI,
INSERVICE INSPECTION (ISI) PROGRAM
(THIRD TEN-YEAR INSPECTION INTERVAL)

REQUESTS FOR RELIEF 2-ISI-19

(See Attached)

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 2
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI,
INSERVICE INSPECTION (ISI) PROGRAM
(THIRD TEN-YEAR INSPECTION INTERVAL)

REQUESTS FOR RELIEF 2-ISI-19

Executive Summary: This request for relief addresses 12 Reactor Pressure Vessel (RPV) nozzle-to-vessel full penetration welds. The design configuration of the RPV nozzle-to-vessel weld precludes a 100 percent ultrasonic (UT) examination of the required volume for the full penetration welds of the nozzles listed in Table 1. These examination limitations occur when the ASME Section XI, 1995 Edition, 1996 Addenda, examination requirements are applied in areas of components constructed and fabricated to early plant designs. Based on a construction permit date prior to January 1, 1971, BFN is exempt from meeting certain provisions of the Code requirements for examination access, to the extent practical, within the limitations of design, geometry, and materials of construction of the components in accordance with 10 CFR 50.55a(g)(4).

A UT examination was performed on accessible areas to the maximum extent practical given the physical limitations of the subject nozzle welds utilizing personnel and techniques qualified in accordance with ASME Section XI Appendix VIII. The design configuration limits UT examination of the RPV nozzle-to-vessel weld coverage (percentage) as shown in Table 1. TVA concludes that performance of an UT examination of essentially 100 percent of the RPV nozzle-to-vessel full penetration welds would be impractical. The performance of the UT examination of the subject areas to the maximum extent practical provides an acceptable level of quality and safety because the information and data obtained from the volume examined provides

	sufficient information to judge the overall integrity of the welds. Therefore, pursuant to 10 CFR 50.55a(g)(5)(iii), it is requested that relief be granted for the Third Ten-Year ISI inspection interval.
Unit:	Two (2)
ISI Interval:	ASME Section XI, Third Ten-Year ISI Inspection Interval (May 25, 2001 to May 24, 2011)
System:	Reactor Pressure Vessel (RPV), System 329
Components:	12 RPV Nozzles, Full Penetration Welds as listed in Table 1
ASME Code Class:	ASME Code Class 1 (Equivalent)
ASME Section XI Code Edition:	1995 Edition, 1996 Addenda
Code Table:	IWB-2500-1
Examination Category:	B-D, Full Penetration Welds of Nozzles in Vessels
Examination Item Number:	B3.90, Reactor Vessel Nozzle-to-Vessel Welds
Code Requirement:	ASME Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.90 requires a volumetric examination of essentially 100 percent of the weld and adjacent base material as depicted in Figure IWB-2500-7(a).
Code Requirements From Which Relief Is Requested:	Relief is requested from the requirement of ASME Section XI Code, Table IWB-2500-1, Examination Category, B-D, Item No. B3.90 to perform essentially 100 percent volumetric examination of weld and adjacent base material as depicted in Figure IWB-2500-7(a).

List Of Items Associated With The Relief Request:

N1A - RPV Nozzle-to-Vessel Weld
N2B - RPV Nozzle-to-Vessel Weld
N2F - RPV Nozzle-to-Vessel Weld
N2J - RPV Nozzle-to-Vessel Weld
N3D - RPV Vessel-to-Nozzle Weld
N4A - RPV Nozzle-to-Vessel Weld
N4B - RPV Nozzle-to-Vessel Weld
N4C - RPV Nozzle-to-Vessel Weld
N4D - RPV Nozzle-to-Vessel Weld
N4E - RPV Nozzle-to-Vessel Weld
N4F - RPV Nozzle-to-Vessel Weld
N8A - RPV Nozzle-to-Vessel Weld

Basis For Relief Request:

The design configuration of the RPV nozzle-to-vessel welds precludes an UT examination of essentially 100 percent of the required volume. The component design configuration limits UT examination coverage of the welds to the percentages listed in Table 1.

Alternative Examination:

None. In lieu of the Code require essentially 100 percent volume UT examination, TVA proposes a UT examination of accessible areas to the maximum extent practical given the component design configuration of the RPV nozzle-to-vessel welds.

Justification for The Granting of Relief:

The design configuration of the subject nozzle-to-vessel welds precludes UT examination of essentially 100 percent of the required examination volume. Access to the nozzle-to-vessel welds is by a series of doorways in the concrete biological shield wall. Insulation behind these doorways is designed for removal around the nozzle circumference. In order to examine the welds in accordance with the code requirements the RPV would require extensive design modifications. The physical arrangements of

the nozzle-to-vessel weld precludes UT examination from the nozzle side. The limitations are inherent to the barrel-type nozzle-to-vessel weld design and is compounded by the close proximity of the biological shield wall.

Scanning from the nozzle surface is ineffective due to the weld location and the asymmetrical inside surface where the nozzle and vessel converge. Coverage was increased by scanning from the outside blend radius of the weld where practical. Experience from the automated UT examination performed from the inside surface has shown that the nozzle-to-vessel weld coverage will not be greatly improved even if performed from the inside surface utilizing the current state-of-the-art techniques.

The configuration of the nozzle-to-vessel welds precludes UT examination from the nozzle side due to the weld location and the asymmetrical inside surface where the nozzle and vessel converge. The extent of examination coverage from the vessel side provides reasonable assurance that no flaws oriented parallel to the weld are present.

The areas receiving little or no examination coverage are located toward the outside surface of the reactor vessel in the general area of the nozzle outside blend radius. (The blend radius restricts the scanning movement and/or transducer contact) The reactor vessel inner-half of the thickness and inside surface are interrogated with the UT beam. Degradation located at the inside surface or inner-half of the vessel would be located. It should be noted that the nozzle inside radius section received essentially 100 percent examination coverage on these nozzles.

Radiographic examination as an alternate volumetric examination method was determined to be impractical due the radiological concerns. Gaining access to the inside surface of the RPV to place radiographic

film would require extensive personnel protection due to high radiation and contamination levels. Also, due to the varying thickness at the outside blend radius of the weld several radiographs may be required of one area to obtain the required coverage and/or film density. The additional Code coverage gained by radiography is impractical when weighed against the radiological concerns.

Therefore, TVA concludes that performing an UT examination of essentially 100 percent of the nozzle-to-vessel full penetration welds in the RPV would be impractical. Further, it would also be impractical to perform other volumetric examinations (i.e., radiography) which may increase examination coverage. A maximum extent practical UT examination of the subject areas provides an acceptable level of quality and safety. TVA concludes that significant degradation, if present, would be detected during an UT examination performed to the maximum extent practical of the subject welds. As a result, reasonable assurance of operational readiness of the subject welds has been provided.

This request for relief is consistent with a previous Request For Relief 2-ISI-6 for the BFN RPV nozzle-to-vessel full penetration welds submitted and approved by the NRC in the second interval.

Therefore, pursuant to 10 CFR 50.55a(g)(5)(iii), TVA requests that relief be granted for the Third Ten-Year inspection interval.

Implementation Schedule:

This request for relief is applicable to the Third Ten-Year ISI inspection interval for BFN Unit 2 (May 25, 2001 to May 24, 2011).

The nozzle-to-vessel welds listed in Table 1 were examined in the first period (Cycle 12 operation) of the Third Ten-Year ISI inspection interval.

References: TVAN Nondestructive Examination Procedure N-GP-28 titled, "Calculation of ASME Code Coverage for Section XI NDE Examinations."

ISI Program Dwgs:
2-ISI-0270-C Sheets 1 and 2
2-ISI-0269-C Sheet 1 of 1
2-ISI-0222-C Sheet 1 of 4
2-ISI-0410-C Sheet 1 of 1

Examination Data Report:
N1A - Report No. R-160 (Cycle 12)
N2B - Report No. R-161 (Cycle 12)
N2F - Report No. R-162 (Cycle 12)
N2J - Report No. R-163 (Cycle 12)
N3D - Report No. R-164 (Cycle 12)
N4A - Report No. R-141 (Cycle 12)
N4B - Report No. R-142 (Cycle 12)
N4C - Report No. R-143 (Cycle 12)
N4D - Report No. R-144 (Cycle 12)
N4E - Report No. R-145 (Cycle 12)
N4F - Report No. R-146 (Cycle 12)
N8A - Report No. R-165 (Cycle 12)

TABLE 1

WELD NUMBER	NPS	ISI DRAWING	PERCENT EXAMINED	REMARKS
N1A (Recirc Outlet)	28"	2-ISI-0270-C	48.8%	Nozzle to Vessel Weld 43 and 60 degree shear and 43 and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N2B (Recirc Inlet)	12"	2-ISI-0270-C	51.5%	Nozzle to Vessel Weld 40, 43, 63 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N2F (Recirc Inlet)	12"	2-ISI-0270-C	51.5%	Nozzle to Vessel Weld 40, 60 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N2J (Recirc Inlet)	12"	2-ISI-0270-C	51.5%	Nozzle to Vessel Weld 40, 58 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.

TABLE 1 (Cont.)

NOZZLE NUMBER	NPS	ISI DRAWING	PERCENT EXAMINED	REMARKS
N3D (Main Steam)	26"	2-ISI-0222-C	47.3%	Nozzle to Vessel Weld 41, 58 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N4A (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 41, 58, degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4B (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 42, 59 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.

TABLE 1 (Cont.)

NOZZLE NUMBER	NPS	ISI DRAWING	PERCENT EXAMINED	REMARKS
N4C (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 42, 60 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4D (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 42, 59, degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.

TABLE 1 (Cont.)

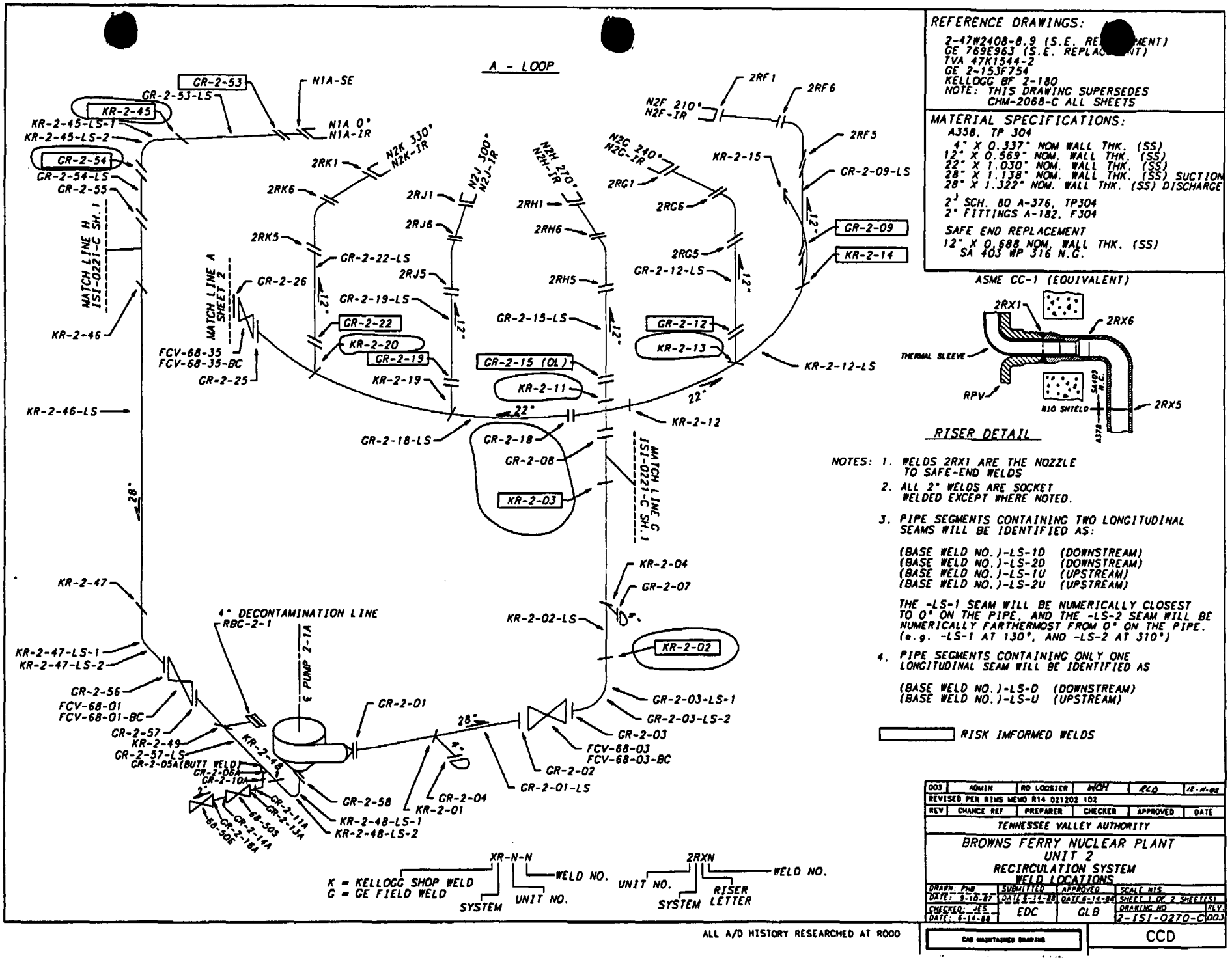
NOZZLE NUMBER	NPS	ISI DRAWING	PERCENT EXAMINED	REMARKS
N4E (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 42, 59 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4F (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 42, 59 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N8A (Recirc Instr. Nozzle)	4"	2-ISI-0410-C	89.5%	Nozzle to Vessel Weld 50 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and Circumferential RPV weld C-BH-1. The 60 degree radial scan was limited by approximately 4.8 percent due to lift off on upper toe of nozzle to vessel weld. Exams performed from the shell side.

Attachment A

2-ISI-19

Five (5) Sketches

2-ISI-0270-C, Sheets 1 and 2
2-ISI-0269-C, Sheet 1 of 1
2-ISI-0222-C, Sheet 1 of 4
2-ISI-0410-C, Sheet 1 of 1



REFERENCE DRAWINGS:

2-47W2408-8,9 (S.E. RE[illegible]MENT)
GE 769E963 (S.E. REPLAC[illegible]NT)
TVA 47K1544-2
GE 2-153F754
KELLOGG BF 2-180
NOTE: THIS DRAWING SUPERSEDES CHM-2068-C ALL SHEETS

MATERIAL SPECIFICATIONS:

A358, TP 304
4" X 0.337" NOM WALL THK. (SS)
12" X 0.569" NOM. WALL THK. (SS)
22" X 1.030" NOM. WALL THK. (SS)
28" X 1.138" NOM. WALL THK. (SS) SUCTION
28" X 1.322" NOM. WALL THK. (SS) DISCHARGE

2" SCH. 80 A-376, TP304
2" FITTINGS A-182, F304

SAFE END REPLACEMENT
12" X 0.688 NOM. WALL THK. (SS)
SA 403 WP 316 N.G.

ASME CC-1 (EQUIVALENT)

RISER DETAIL

NOTES:
1. WELDS 2RX1 ARE THE NOZZLE TO SAFE-END WELDS
2. ALL 2" WELDS ARE SOCKET WELDED EXCEPT WHERE NOTED.
3. PIPE SEGMENTS CONTAINING TWO LONGITUDINAL SEAMS WILL BE IDENTIFIED AS:

(BASE WELD NO.)-LS-1D (DOWNSTREAM)
(BASE WELD NO.)-LS-2D (DOWNSTREAM)
(BASE WELD NO.)-LS-1U (UPSTREAM)
(BASE WELD NO.)-LS-2U (UPSTREAM)

THE -LS-1 SEAM WILL BE NUMERICALLY CLOSEST TO 0° ON THE PIPE, AND THE -LS-2 SEAM WILL BE NUMERICALLY FARTHERMOST FROM 0° ON THE PIPE. (e.g. -LS-1 AT 130°, AND -LS-2 AT 310°)

4. PIPE SEGMENTS CONTAINING ONLY ONE LONGITUDINAL SEAM WILL BE IDENTIFIED AS

(BASE WELD NO.)-LS-D (DOWNSTREAM)
(BASE WELD NO.)-LS-U (UPSTREAM)

RISK IMFORMED WELDS

003	ADMIN	RD LOOSIER	WCH	RLD	12-11-98
REVISED PER RIMS MEMO R14 021202 102					
REV	CHANGE REF	PREPARER	CHECKER	APPROVED	DATE

TENNESSEE VALLEY AUTHORITY

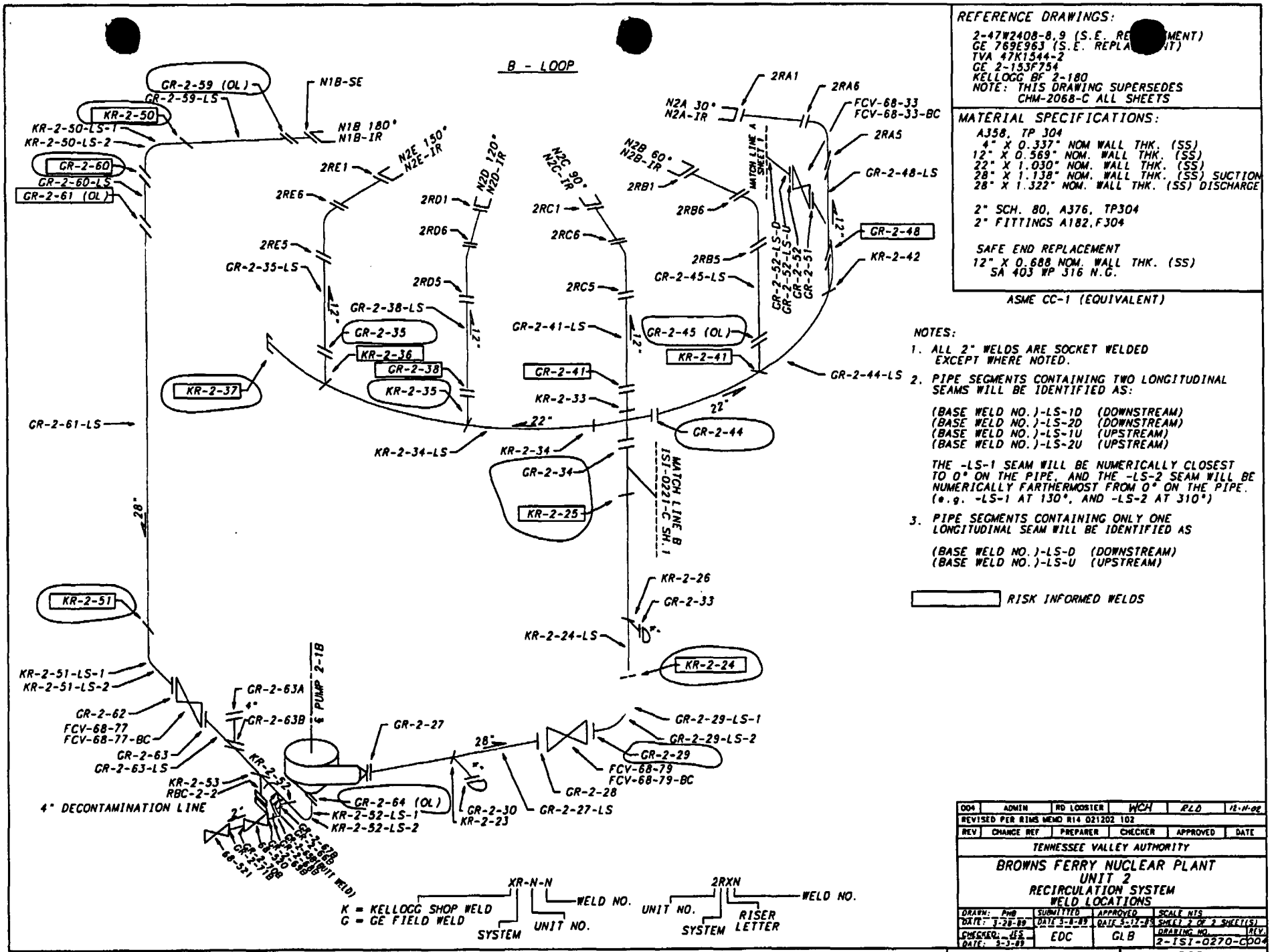
BROWNS FERRY NUCLEAR PLANT
UNIT 2
RECIRCULATION SYSTEM
WELD LOCATIONS

DRAWN: PHB	SUBMITTED	APPROVED	SCALE NTS
DATE: 9-10-87	DATE 6-14-88	DATE 6-14-88	SHEET 1 OF 2 SHEET(S)
CHECKED: JES	EDC	CLB	DRAWING NO. 2-ISI-0270-C
DATE: 6-14-88			REV. 003

CAD MAINTAINED DRAWING

CCD

ALL A/D HISTORY RESEARCHED AT ROOO



REFERENCE DRAWINGS:

2-47W2408-8,9 (S.E. RE[redacted]MENT)
GE 769E963 (S.E. REPLA[redacted]T)
TVA 47K1544-2
GE 2-153F754
KELLOGG BF 2-180
NOTE: THIS DRAWING SUPERSEDES CHM-2068-C ALL SHEETS

MATERIAL SPECIFICATIONS:

A358, TP 304
4" X 0.337" NOM WALL THK. (SS)
12" X 0.569" NOM. WALL THK. (SS)
22" X 1.030" NOM. WALL THK. (SS)
28" X 1.138" NOM. WALL THK. (SS) SUCTION
28" X 1.322" NOM. WALL THK. (SS) DISCHARGE

2" SCH. 80, A376, TP304
2" FITTINGS A182, F304

SAFE END REPLACEMENT
12" X 0.688 NOM. WALL THK. (SS)
SA 403 WP 316 N.G.

ASME CC-1 (EQUIVALENT)

NOTES:

1. ALL 2" WELDS ARE SOCKET WELDED EXCEPT WHERE NOTED.
2. PIPE SEGMENTS CONTAINING TWO LONGITUDINAL SEAMS WILL BE IDENTIFIED AS:

   (BASE WELD NO.)-LS-1D (DOWNSTREAM)
   (BASE WELD NO.)-LS-2D (DOWNSTREAM)
   (BASE WELD NO.)-LS-1U (UPSTREAM)
   (BASE WELD NO.)-LS-2U (UPSTREAM)

   THE -LS-1 SEAM WILL BE NUMERICALLY CLOSEST TO 0° ON THE PIPE, AND THE -LS-2 SEAM WILL BE NUMERICALLY FARTHERMOST FROM 0° ON THE PIPE. (e.g. -LS-1 AT 130°, AND -LS-2 AT 310°)
3. PIPE SEGMENTS CONTAINING ONLY ONE LONGITUDINAL SEAM WILL BE IDENTIFIED AS

   (BASE WELD NO.)-LS-D (DOWNSTREAM)
   (BASE WELD NO.)-LS-U (UPSTREAM)

RISK INFORMED WELDS

004	ADMIN	RD LOOSTER	WCH	RLD	12-11-02
REVISED PER RIMS MEMO R14 021202 102					
REV	CHANGE REF	PREPARER	CHECKER	APPROVED	DATE

TENNESSEE VALLEY AUTHORITY

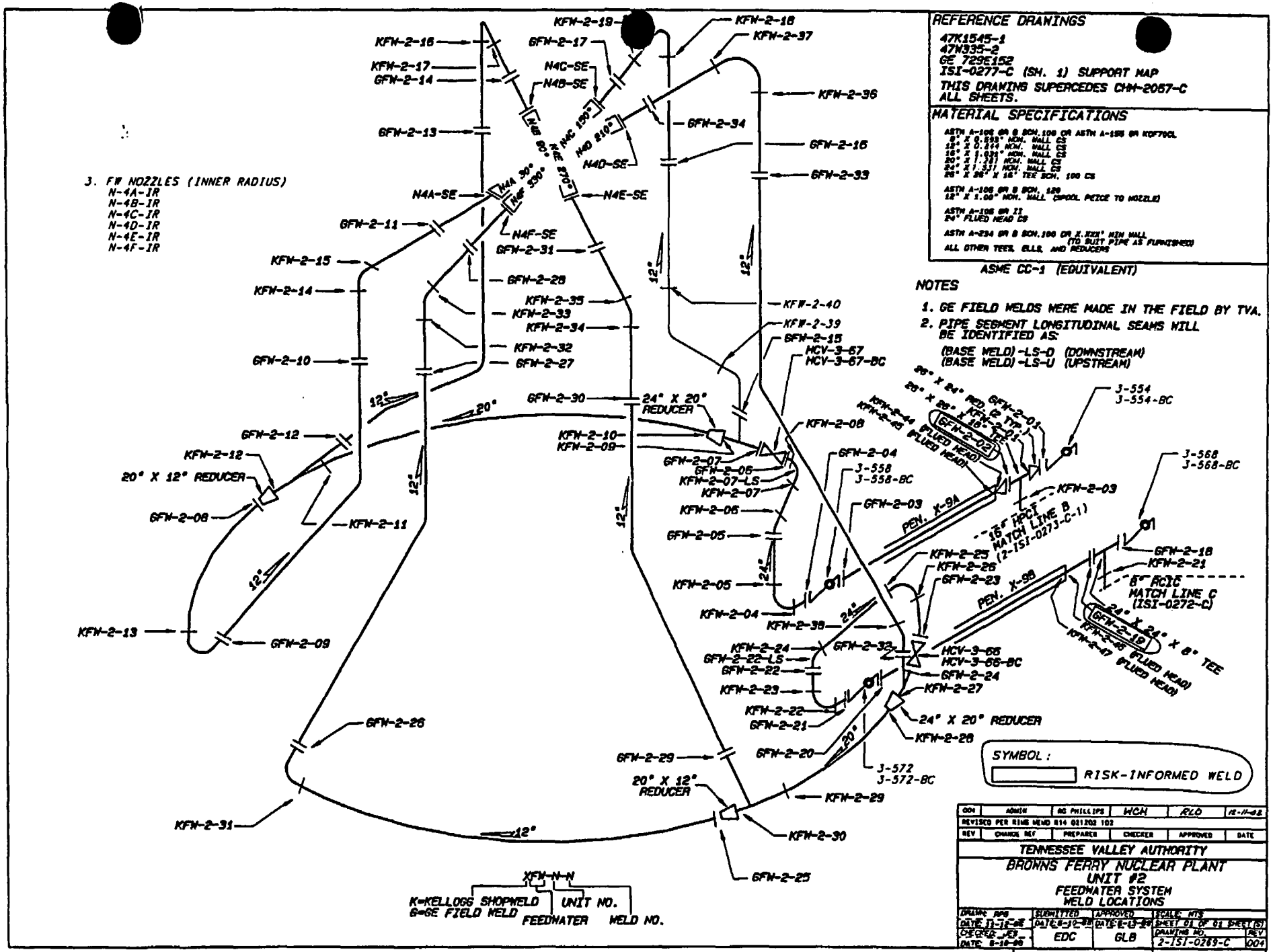
BROWNS FERRY NUCLEAR PLANT
UNIT 2
RECIRCULATION SYSTEM
WELD LOCATIONS

DRAWN: PHB	SUBMITTED	APPROVED	SCALE NTS
DATE: 3-28-89	DATE 5-8-89	DATE 5-17-89	SHEET 2 OF 2 SHEET(S)
CHECKED: JES	EDC	GLB	DRAWING NO. 2-ISI-0270-C004 REV.
DATE: 5-3-89			

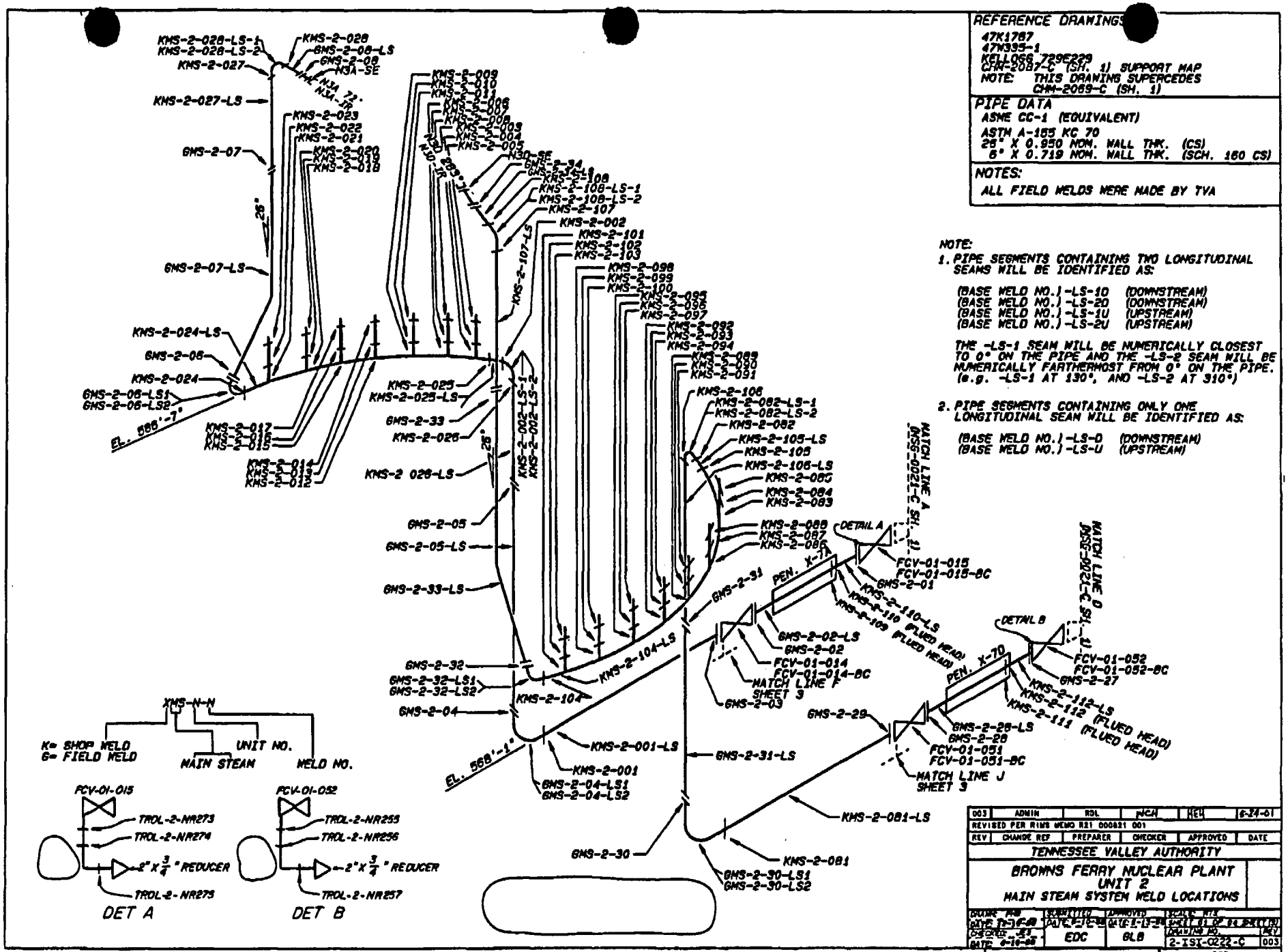
ALL A/D HISTORY RESEARCHED ● ROOO

CAD MAINTAINED DRAWING

CCD



2-ISI-0269-C, Sheet 1



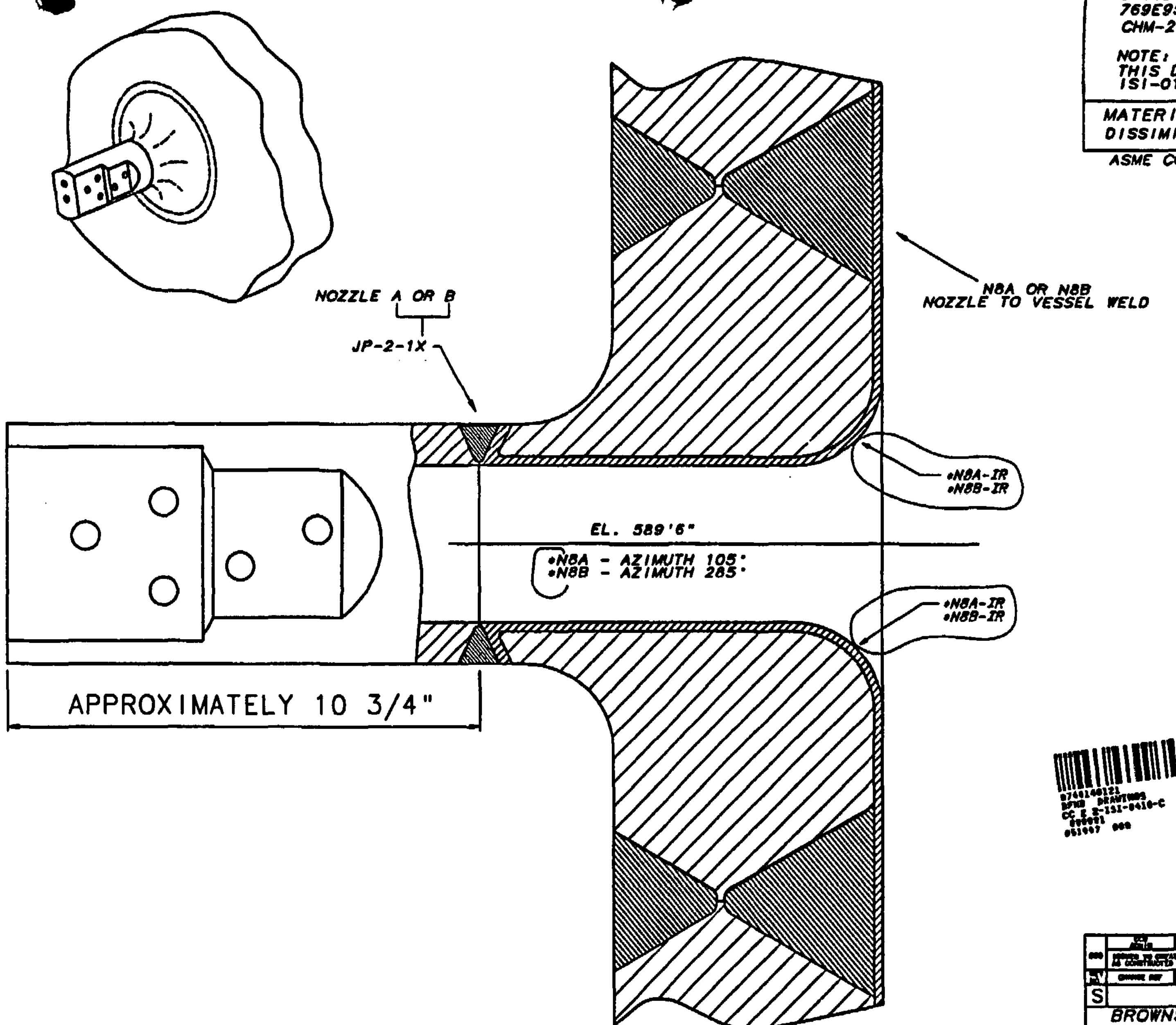
2-ISI-0222-C, Sheet 1

REFERENCE DRAW[illegible]S
0-112D3838 GE ([illegible]54-B835271)
769E957 GE (84P64-B835271)
CHM-2046-C (NOZZLE LOCATIONS)

NOTE:
THIS DRAWING SUPERSEDES
ISI-0156-A

MATERIAL SPECIFICATIONS
DISSIMILAR METAL WELD

ASME CC-1 (EQUIVALENT)



"ORIGINAL"

2-ISI-0410-C, Sheet 1

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT
UNIT 2
JET PUMP INSTRUMENTATION NOZZLE
WELD LOCATIONS

DRAWN: PHB	DATE: 3-13-93	SCALE: NTS	CADAM/ISICMP
CHECKED: RPG	APPROVED: GLB	SHEET 01 OF 01	REV
SUBMITTED: JES		2-ISI-0410-C	000
		CCD	

ALL A/D HISTORY RESEARCHED AT R000

Attachment B

2-ISI-19

Weld Examination Data Reports

N1A - Report No. R-160 (Excerpt)
N2B - Report No. R-161 (Excerpt)
N2F - Report No. R-162 (Excerpt)
N2J - Report No. R-163 (Excerpt)
N3D - Report No. R-164 (Excerpt)
N4A - Report No. R-141 (Excerpt)
N4B - Report No. R-142 (Excerpt)
N4C - Report No. R-143 (Excerpt)
N4D - Report No. R-144 (Excerpt)
N4E - Report No. R-145 (Excerpt)
N4F - Report No. R-146 (Excerpt)
N8A - Report No. R-165 (Excerpt)

Weld Examination Report

R-160 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

28" Recirculation Outlet Nozzle to Vessel Weld
N1A

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius with the 60 degree RL scans. The weld blend radius configuration restricts the examination coverage. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area:	46.06 sq. in.		
Inner 15% of Weld:	6.21 sq. in.		
	60° Radial Scan from Shell		
Area Examined:	30.24 sq. in.		
	60° Tangential Scan from Shell		
Area Examined:	8.52 sq. in.		
Percent of 60° RL Scans Completed:	(30.24 + 8.52) ÷ 2 =	19.38 ÷ 46.06 x 100 =	42.1%
	Inner 15% of Weld		
Area Examined:	6.21 sq. in.		
Total Percent Examination Completed:	= (6.21 + 8.52 + 30.24) ÷ 2 =	22.49 ÷ 46.06 x 100 =	48.8%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
28" RECIRCULATION OUTLET NOZZLE TO VESSEL WELD
N1A NOZZLE

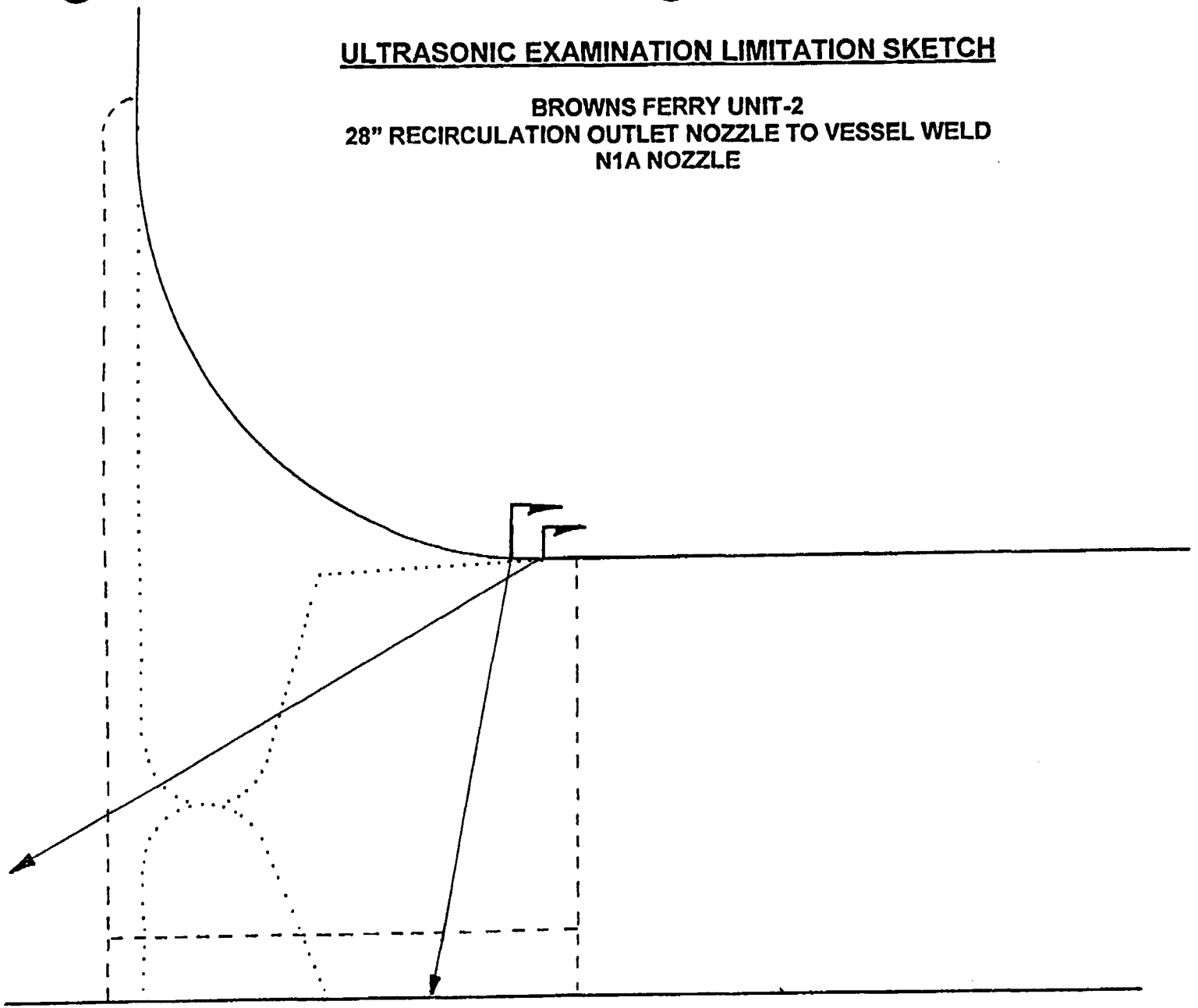


Table 1. Browns Ferry Recirculation Outlet Nozzle (N1)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	24.188	Weld End R	29.153
Taper Angle, ID	15	Taper Angle, OD	0
Zbore	144.375		
Rbore	13.138	Rnozzle	26.5
Rbi	3	Rbo	5.75
Rvi	125.6875	Rvo	131.9375

Table 2. Spreadsheet Model Techniques for Recirculation Outlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(60 to 78)	Vessel	Shear Wave
43	±106	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Recirculation Outlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(60 to 78)	Vessel	31.90	33.66	9.92	14.77	10
43	±106	Blend	27.34	30.03	7.66	15.76	12

Weld Examination Report

R-161 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Recirculation Inlet Nozzle to Vessel Weld
N2B

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the Inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

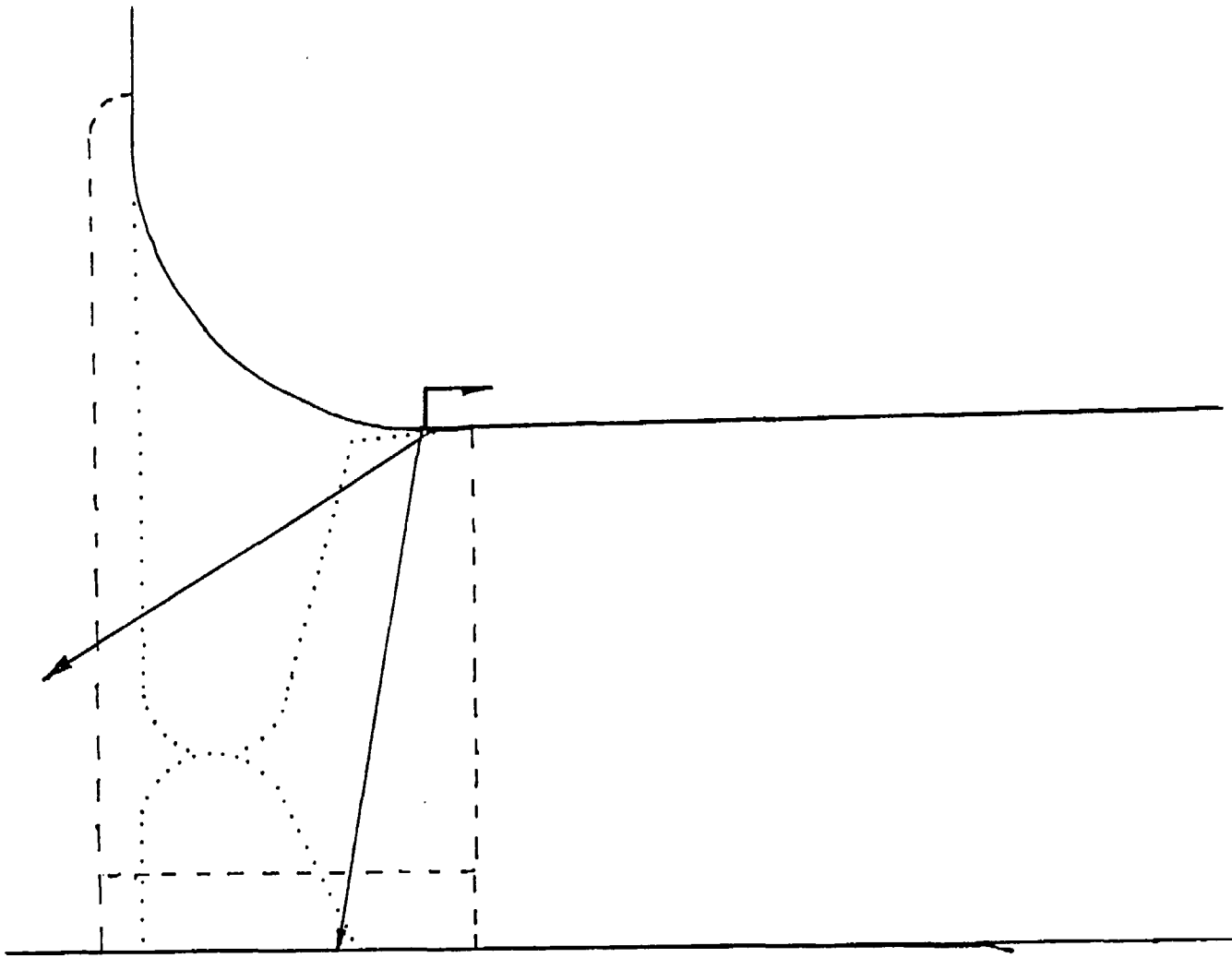
Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius with the 60 degree RL scans. The weld blend radius configuration restricts the examination coverage. All other angles used for ultrasonic examination of the Inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area :	32.83 sq. In.		
Inner 15% of Weld:	4.19 sq. In.		
	60° Radial Scan from Shell		
Area Examined:	23.04 sq. In.		
	60° Tangential Scan from Shell		
Area Examined:	6.6 sq. In.		
Percent of 60° RL Scans Completed:	(23.04 + 6.6) ÷ 2 =	14.82 ÷ 32.83 x 100 =	45.1%
	Inner 15% of Weld		
Area Examined:	4.19 sq. In.		
Total Percent Examination Completed:	= (4.19 + 6.6 + 23.04) ÷ 2 =	16.92 ÷ 32.83 x 100 =	51.5%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" RECIRCULATION INLET NOZZLE TO VESSEL WELD
N2 NOZZLES



00412 R.16

Table 1. Browns Ferry Recirculation Inlet Nozzle (N2)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	10.813	Weld End R	15.153
Rbore	5.94	Rnozzle	12.5
Rbi	2.25	Rbo	3.5
Rvi	125.375	Rvo	131.625

Table 2. Spreadsheet Model Techniques for Recirculation Inlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(36 to 66)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Recirculation Inlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(36 to 66)	Vessel	16.56	20.48	9.92	14.76	6
40	±120	Blend	12.93	14.02	7.63	11.14	4

Weld Examination Report

R-162 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Recirculation Inlet Nozzle to Vessel Weld
N2F

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

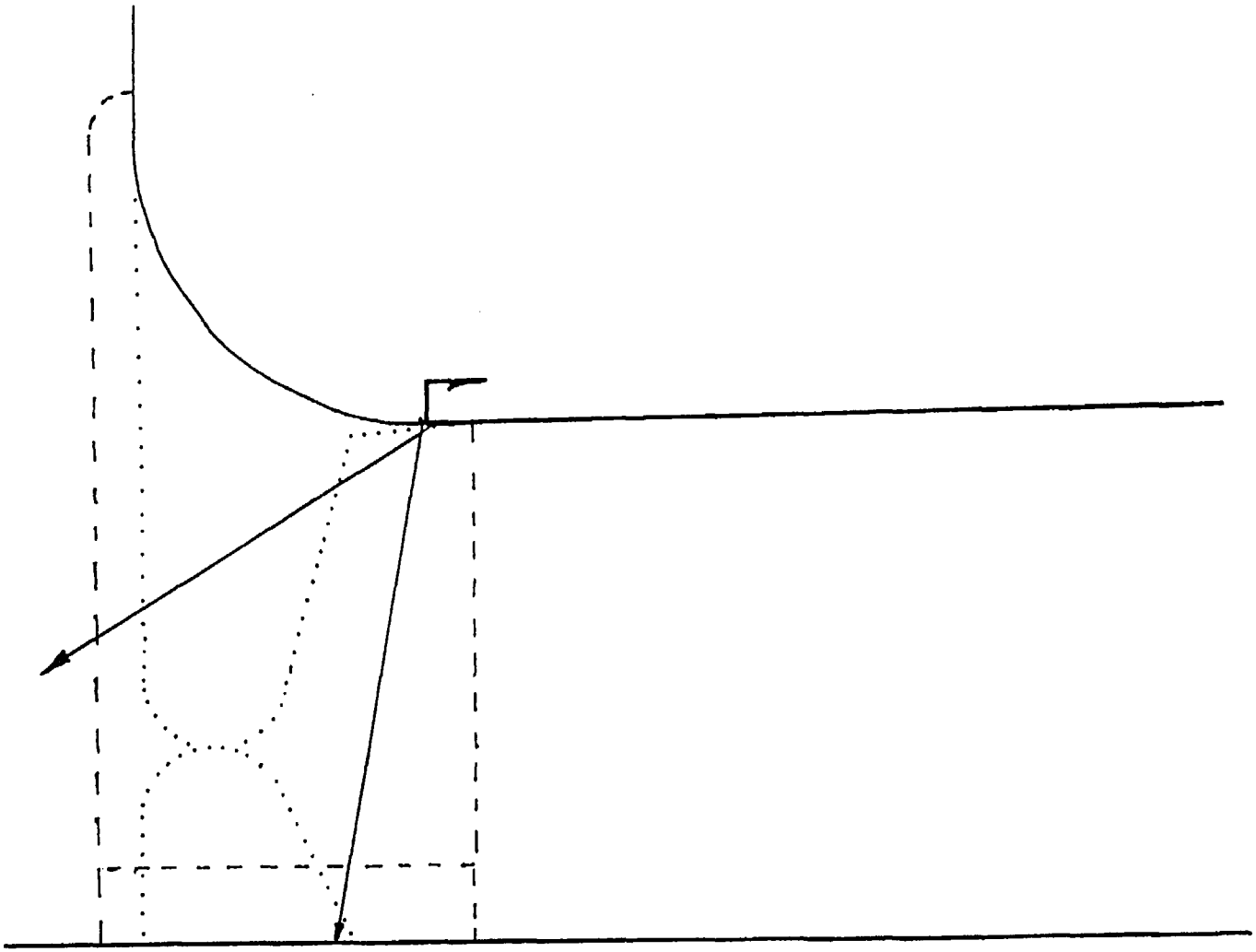
Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius with the 60 degree RL scans. The weld blend radius configuration restricts the examination coverage. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area :	**32.83 sq. in.**		
Inner 15% of Weld:	**4.19 sq. in.**		
	60° Radial Scan from Shell		
Area Examined:	23.04 sq. in.		
	60° Tangential Scan from Shell		
Area Examined:	6.6 sq. in.		
Percent of 60° RL Scans Completed:	(23.04 + 6.6) ÷ 2 =	14.82 ÷ 32.83 x 100 =	**45.1%**
	Inner 15% of Weld		
Area Examined:	4.19 sq. in.		
Total Percent Examination Completed:	= (4.19 + 6.6 + 23.04) ÷ 2 =	16.92 ÷ 32.83 x 100 =	**51.5%**

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" RECIRCULATION INLET NOZZLE TO VESSEL WELD
N2 NOZZLES



00420 R-162

R.162

Table 1. Browns Ferry Recirculation Inlet Nozzle (N2)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	10.813	Weld End R	15.153
Rbore	5.94	Rnozzle	12.5
Rbi	2.25	Rbo	3.5
Rvi	125.375	Rvo	131.625

Table 2. Spreadsheet Model Techniques for Recirculation Inlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(36 to 66)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Recirculation Inlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(36 to 66)	Vessel	16.56	20.48	9.92	14.76	6
40	±120	Blend	12.93	14.02	7.63	11.14	4

Weld Examination Report

R-163 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Recirculation Inlet Nozzle to Vessel Weld
N2J

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

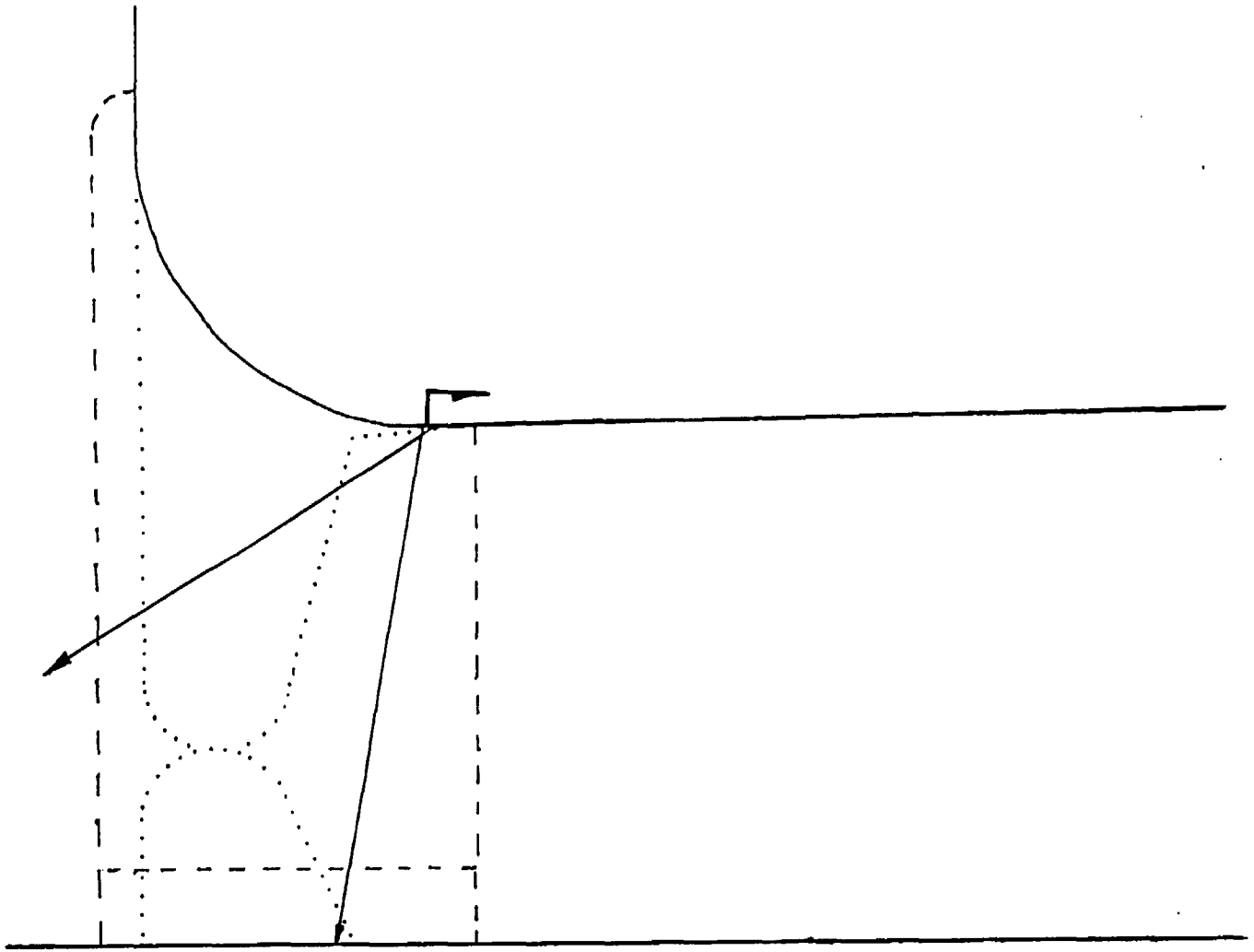
Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius with the 60 degree RL scans. The weld blend radius configuration restricts the examination coverage. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area :	32.83 sq. in.		
Inner 15% of Weld:	4.19 sq. in.		
	60° Radial Scan from Shell		
Area Examined:	23.04 sq. in.		
	60° Tangential Scan from Shell		
Area Examined:	6.6 sq. in.		
Percent of 60° RL Scans Completed:	(23.04 + 6.6) ÷ 2 =	14.82 ÷ 32.83 x 100 =	45.1%
	Inner 15% of Weld		
Area Examined:	4.19 sq. in.		
Total Percent Examination Completed:	= (4.19 + 6.6 + 23.04) ÷ 2 =	16.92 ÷ 32.83 x 100 =	51.5%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" RECIRCULATION INLET NOZZLE TO VESSEL WELD
N2 NOZZLES



00428 R.163

Table 1. Browns Ferry Recirculation Inlet Nozzle (N2)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	10.813	Weld End R	15.153
Rbore	5.94	Rnozzle	12.5
Rbi	2.25	Rbo	3.5
Rvi	125.375	Rvo	131.625

Table 2. Spreadsheet Model Techniques for Recirculation Inlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(36 to 66)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Recirculation Inlet Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(36 to 66)	Vessel	16.56	20.48	9.92	14.76	6
40	±120	Blend	12.93	14.02	7.63	11.14	4

Weld Examination Report

R-164 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

26" Main Steam Nozzle to Vessel Weld
N3D

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius with the 60 degree RL scans. The weld blend radius configuration restricts the examination coverage. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

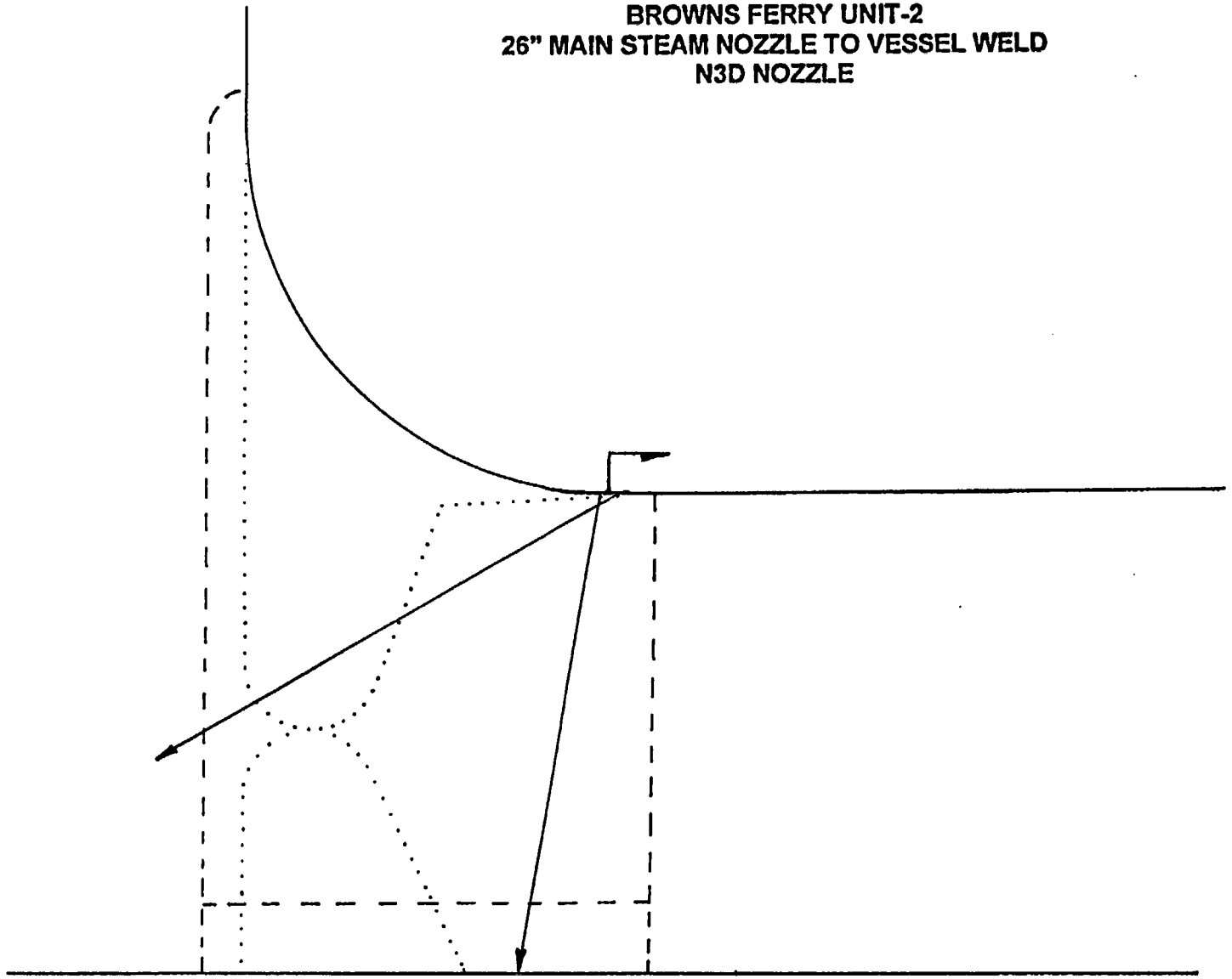
CALCULATIONS

Required Examination Area:	43.36 sq. in.		
Inner 15% of Weld:	5.29 sq. in.		
	60° Radial Scan from Shell		
Area Examined:	27.39 sq. in.		
	60° Tangential Scan from Shell		
Area Examined:	8.33 sq. in.		
Percent of 60° RL Scans Completed:	(27.39 + 8.33) ÷ 2 =	17.86 ÷ 43.36 x 100 =	41.0%
	Inner 15% of Weld		
Area Examined:	5.29 sq. in.		

Total Percent Examination Completed: = (5.29 + 8.33 + 27.39) ÷ 2 = 20.51 ÷ 43.36 x 100 = **47.3%**

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
26" MAIN STEAM NOZZLE TO VESSEL WELD
N3D NOZZLE



00436

R.164

Table 1. Browns Ferry Main Steam Nozzle (N3)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	19.219	Weld End R	23.965
Rbore	12.063	Rnozzle	21.313
Rbi	3.063	Rbo	4.75
Rvi	125.6875	Rvo	131.9375

Table 2. Spreadsheet Model Techniques for Main Steam Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(54 to 74)	Vessel	Shear Wave
40	±115	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Main Steam Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(54 to 74)	Vessel	26.57	27.65	10.04	14.96	8
40	±115	Blend	22.03	24.19	7.29	12.54	14

Weld Examination Report

R-141 (Excerpt)

R.141

00302

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Feedwater Nozzle to Vessel Weld
N4A

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area:	34.89 sq. in.
Inner 15% of Weld:	4.37 sq. in.
	60° Radial Scan from Shell
Area Examined:	23.99 sq. in.
	60° Tangential Scan from Shell
Area Examined:	6.63 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: 4.7%

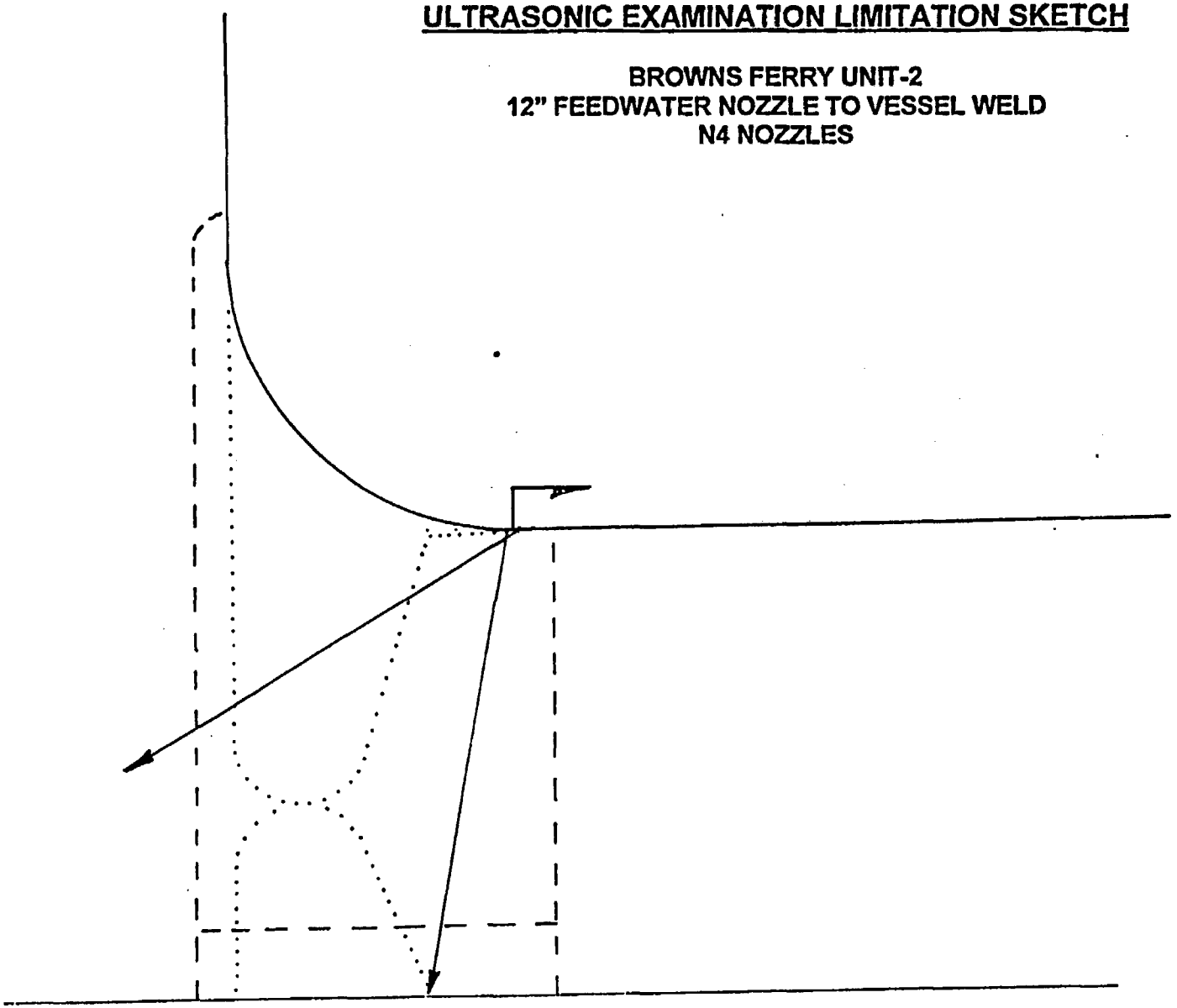
Percent of 60° RL Scans Completed: (23.99 + 6.63) ÷ 2 = 15.31 ÷ 34.89 x 100 = 43.88% – 4.7% = 39.2%

	Inner 15% of Weld
Area Examined:	4.37 sq. in.

Total Percent Examination Completed: (4.37 + 6.63 + 23.99) ÷ 2 = 17.50 ÷ 34.89 x 100 = 50.1% – 4.7% = 45.4%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



00300

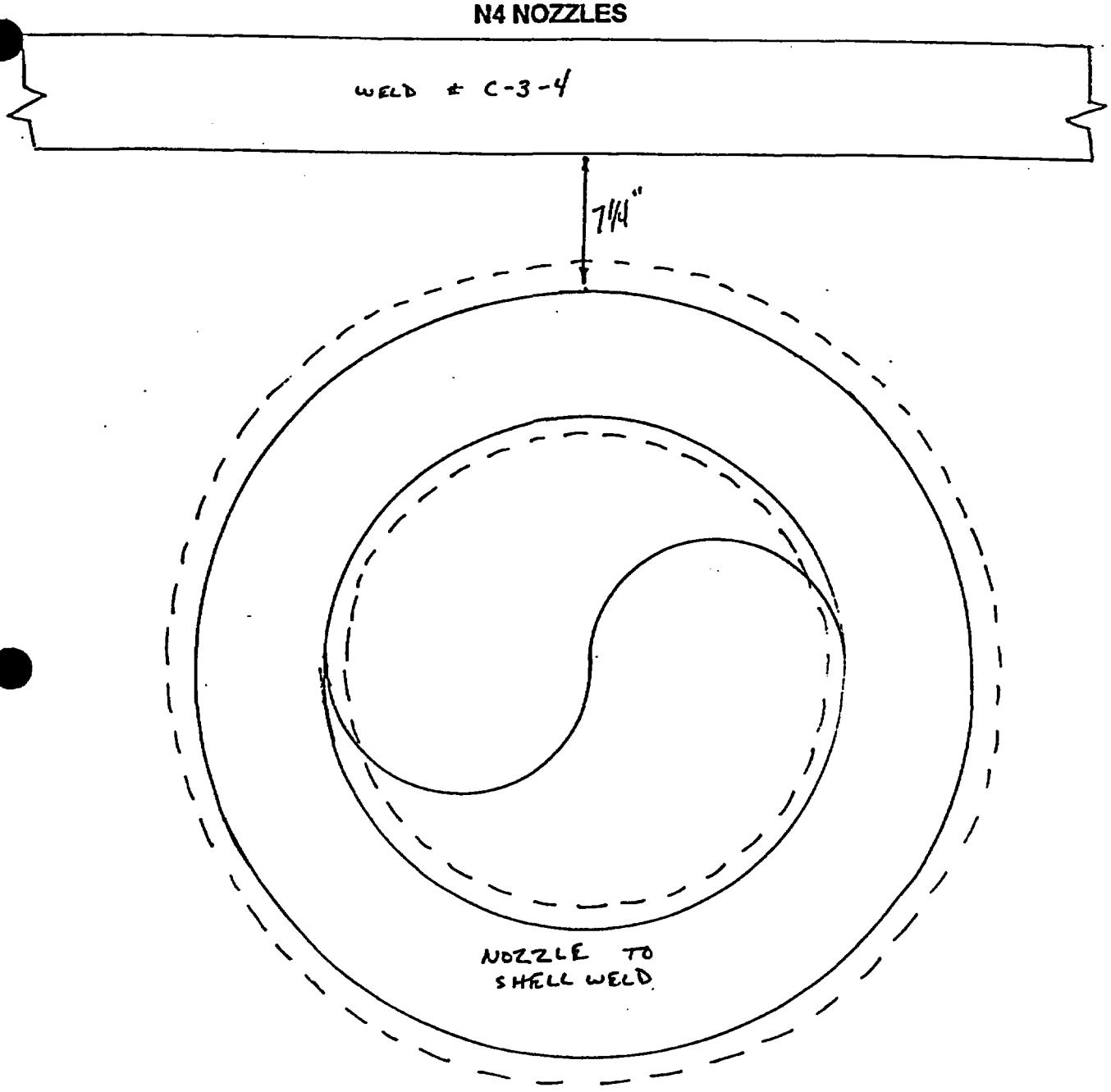
R-11

R.141

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES

00301



60° RL RADIAL SCAN WAS LIMITED BY APPROXIMATELY 4.7% DUE TO LIFT OFF ON LOWER TOE OF GIRTH WELD.

R-141

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INNER RADIUS EXTENSION (NUREG 0619, ZONE 3)

THERMOCOUPLE PAD LIMITATIONS

N4 NOZZLES

Each Thermocouple Pad limits Inner Radius Extension scan by 2.90". There are 2 Thermocouple pads located at approximately 270° on N4A, N4B, N4D and N4F. (See attached Limitation Sketch)

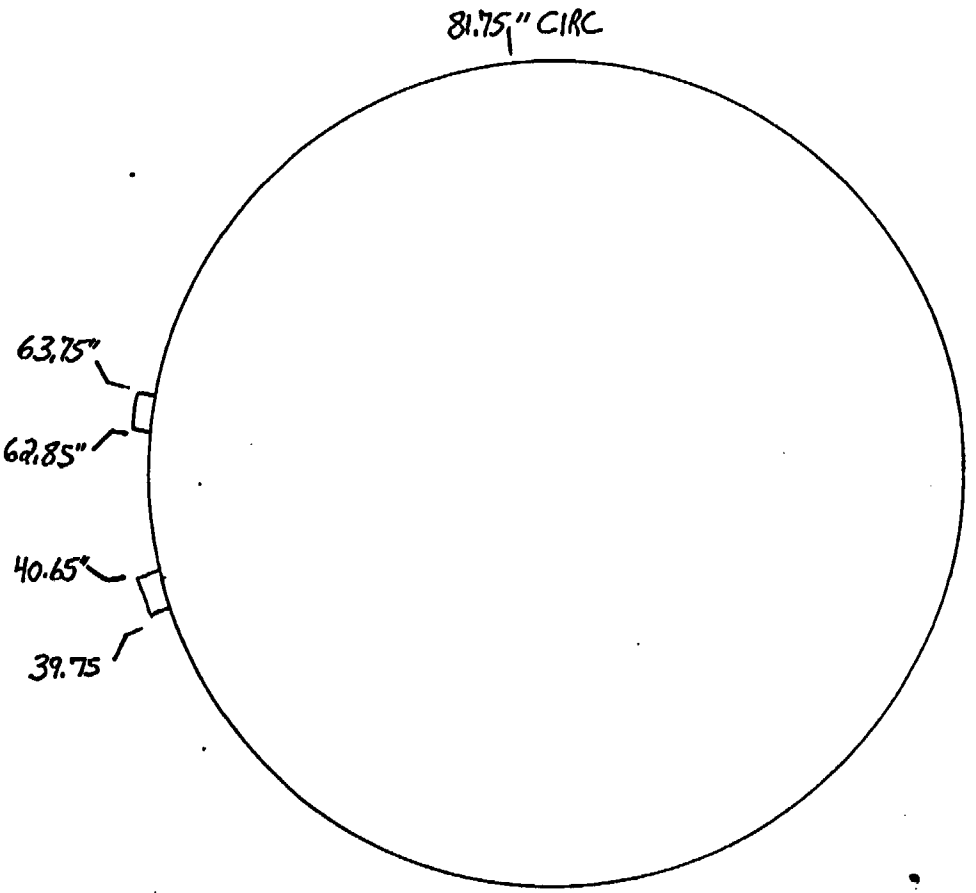
Total Circumferential Measurement of Nozzle Boss: 81.75"

Total Scan Limitation: 2.90" x 2 = 5.80" 5.80" ÷ 81.75" x 100 = 7% Limitation 100% – 7% = 93%

Total Nozzle Inner Radius Extension Coverage = 93%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INSIDE RADIUS EXTENSION (NUREG 0619, ZONE 3)
N4 NOZZLES



THERMOCOUPLE LIMITATION

00314

N/A

Weld Examination Report

R-142 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Feedwater Nozzle to Vessel Weld
N4B

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area:	34.89 sq. in.
Inner 15% of Weld:	4.37 sq. in.
	60° Radial Scan from Shell
Area Examined:	23.99 sq. in.
	60° Tangential Scan from Shell
Area Examined:	6.63 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: 4.7%

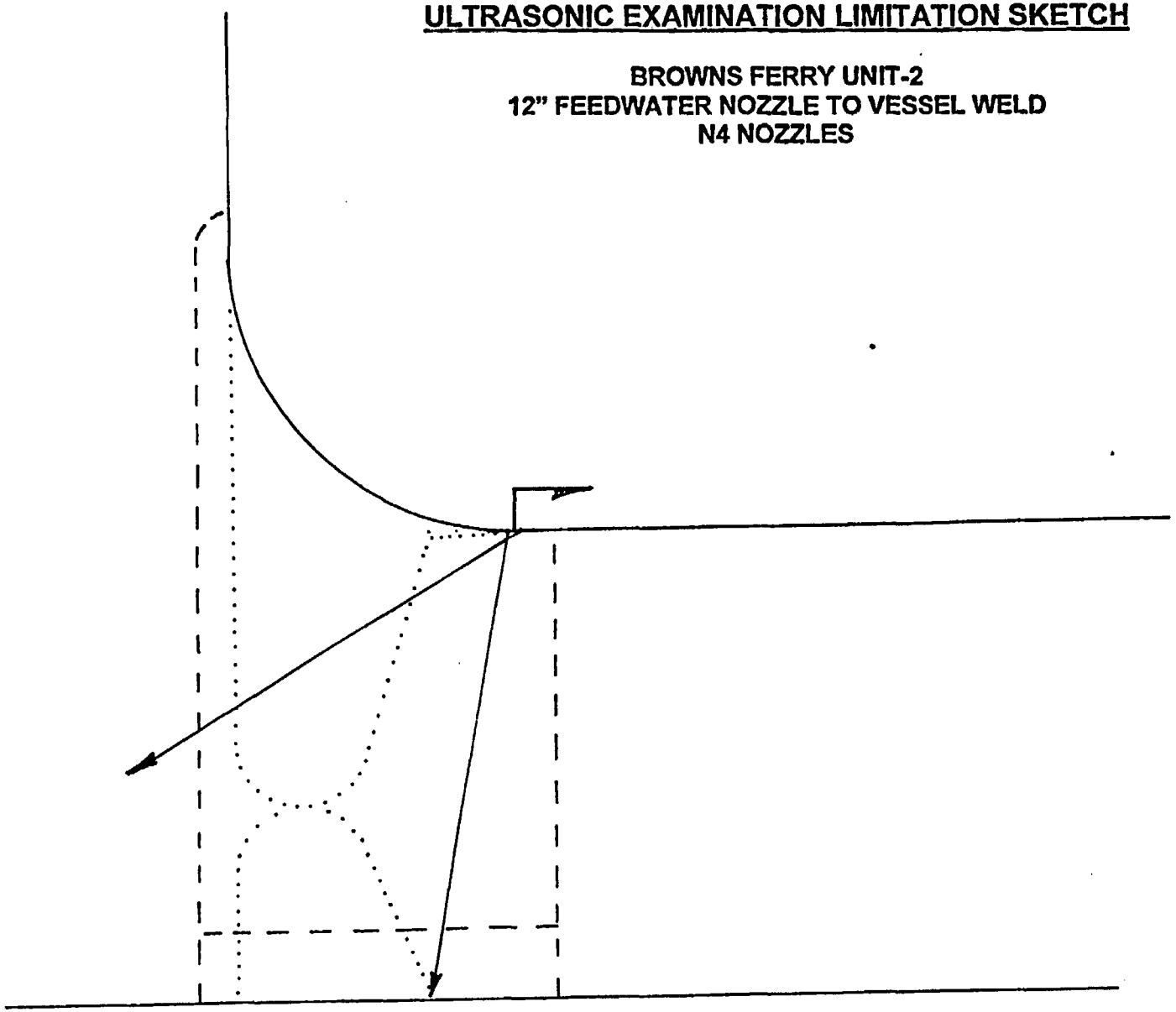
Percent of 60° RL Scans Completed: (23.99 + 6.63) ÷ 2 = 15.31 ÷ 34.89 x 100 = 43.88% – 4.7% = 39.2%

	Inner 15% of Weld
Area Examined:	4.37 sq. in.

Total Percent Examination Completed: (4.37 + 6.63 + 23.99) ÷ 2 = 17.50 ÷ 34.89 x 100 = 50.1% – 4.7% = 45.4%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



00331

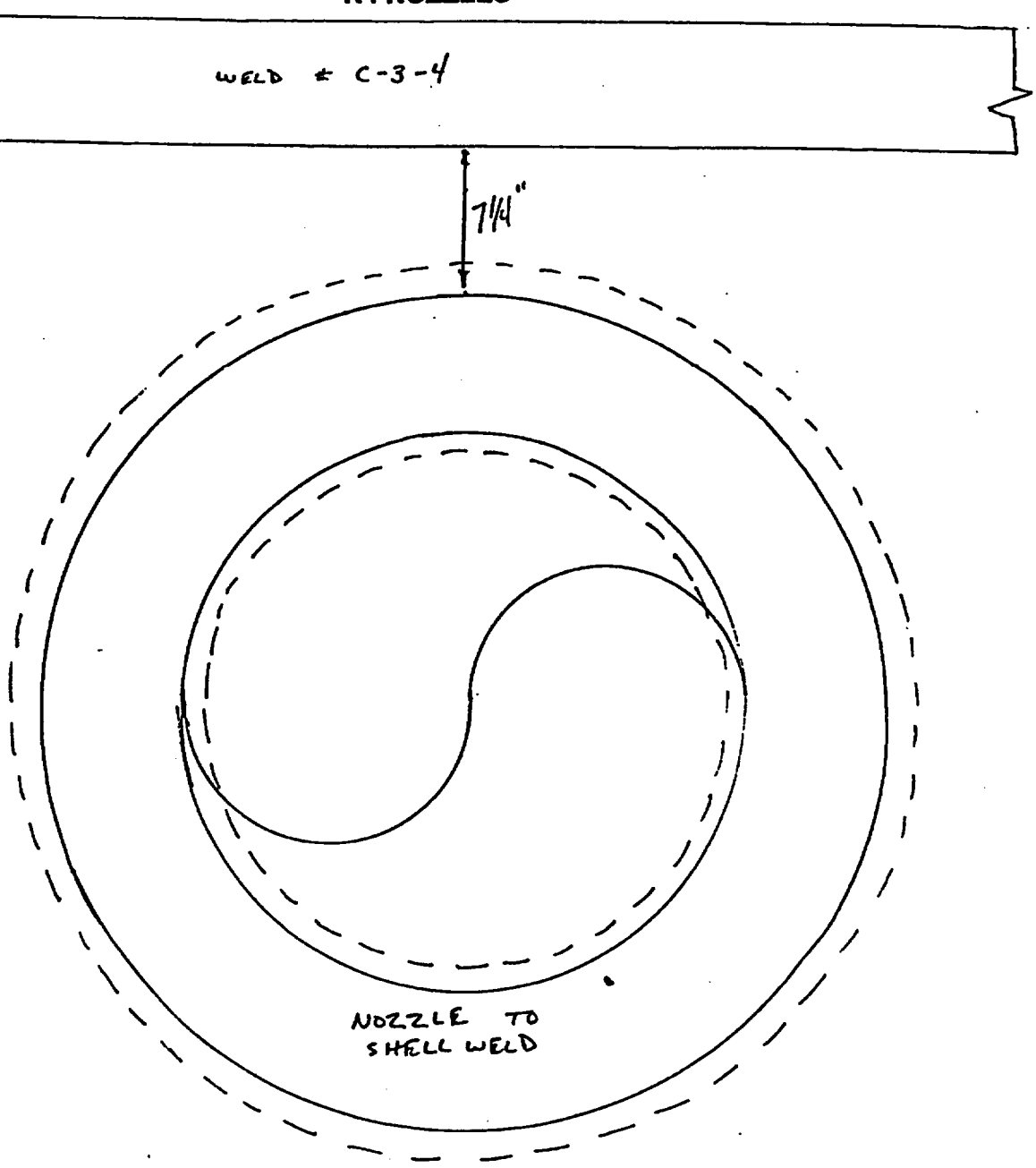
R.142

ULTRASONIC EXAMINATION LIMITATION SKETCH

R.142

00317

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



60° RL RADIAL SCAN WAS LIMITED BY APPROXIMATELY 4.7% DUE TO LIFT OFF ON LOWER TOE OF GIRTH WELD.

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INNER RADIUS EXTENSION (NUREG 0619, ZONE 3)

THERMOCOUPLE ATTACHMENT PAD LIMITATIONS

N4B

Each Thermocouple Attachment Pad limits Inner Radius Extension scan by 2.90". There are 2 Thermocouple Attachment Pads located at approximately 270° on N4A, N4B, N4D and N4F. (See attached Limitation Sketch)

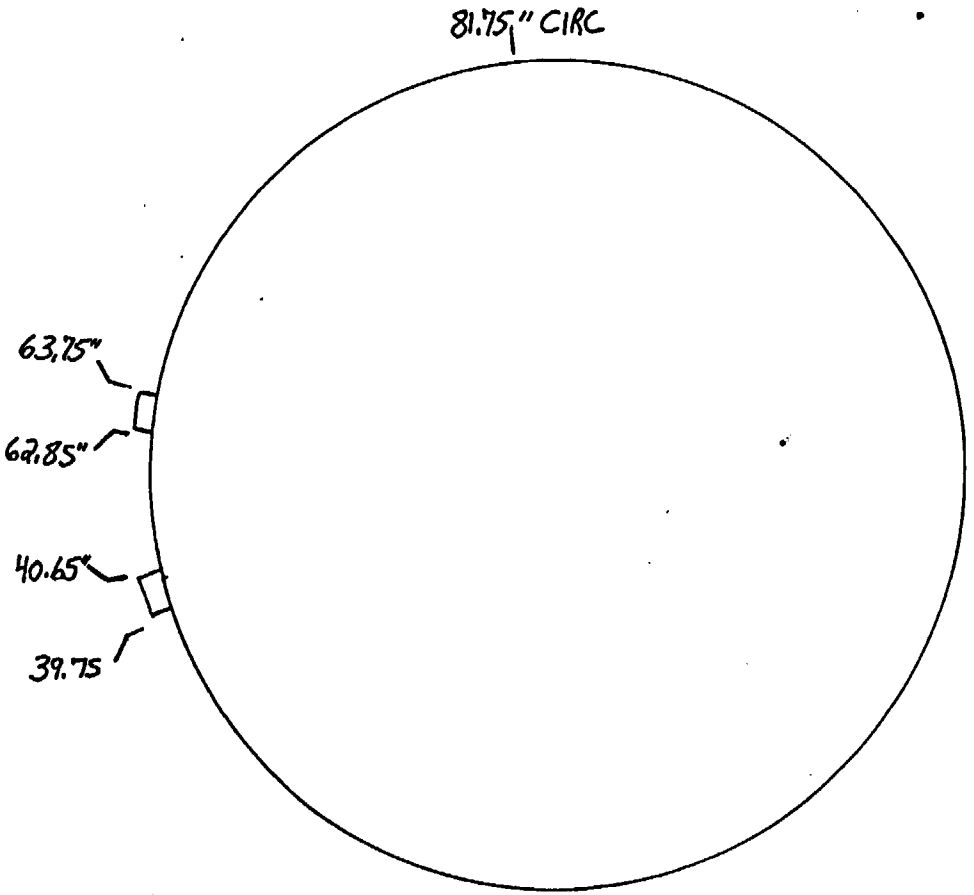
Total Circumferential Measurement of Nozzle Boss: 81.75"

Total Scan Limitation: 2.90" x 2 = 5.80" 5.80" ÷ 81.75" x 100 = 7% Limitation 100% – 7% = 93%

Total Nozzle Inner Radius Extension Coverage = 93%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INSIDE RADIUS EXTENSION (NUREG 0619, ZONE 3)
N4 NOZZLES



THERMOCOUPLE LIMITATION

00329 R.142

Table 1. Browns Ferry Feedwater Nozzle (N4)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	11.25	Weld End R	15.60
Rbore	6	Rnozzle	13
Rbi	3	Rbo	3.75
Rvi	125.6875	Rvo	131.8125

Table 2. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(35 to 67)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(35 to 67)	Vessel	17.27	20.71	9.73	14.44	20
40	±120	Blend	13.45	14.55	7.64	11.35	6

Weld Examination Report

R-143 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Feedwater Nozzle to Vessel Weld
N4C

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area: 34.89 sq. in.
Inner 15% of Weld: 4.37 sq. in.

60° Radial Scan from Shell
Area Examined: 23.99 sq. in.

60° Tangential Scan from Shell
Area Examined: 6.63 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: 4.7%

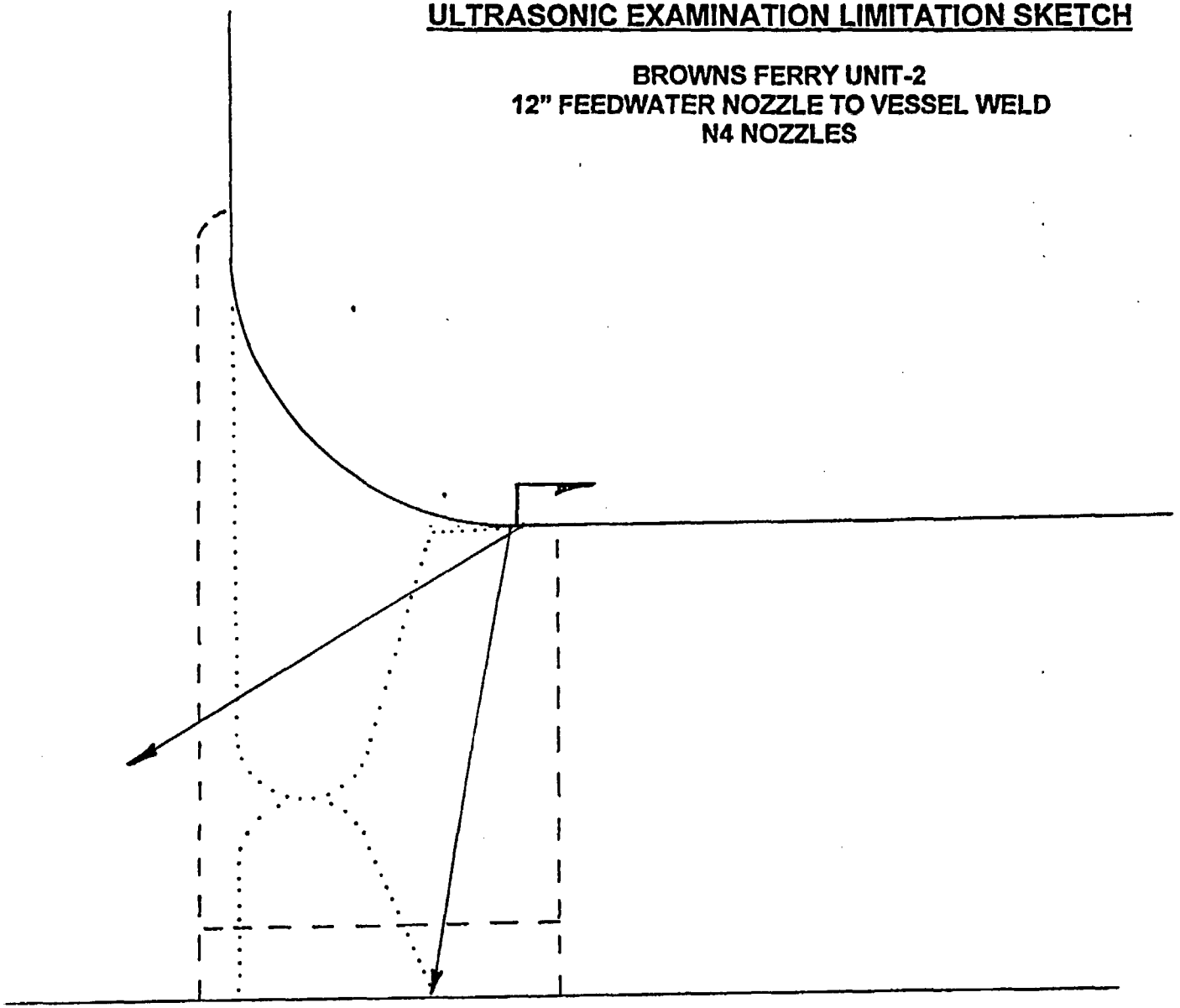
Percent of 60° RL Scans Completed: (23.99 + 6.63) ÷ 2 = 15.31 ÷ 34.89 x 100 = 43.88% – 4.7% = 39.2%

Inner 15% of Weld
Area Examined: 4.37 sq. in.

Total Percent Examination Completed: (4.37 + 6.63 + 23.99) ÷ 2 = 17.50 ÷ 34.89 x 100 = 50.1% – 4.7% = 45.4%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



00336

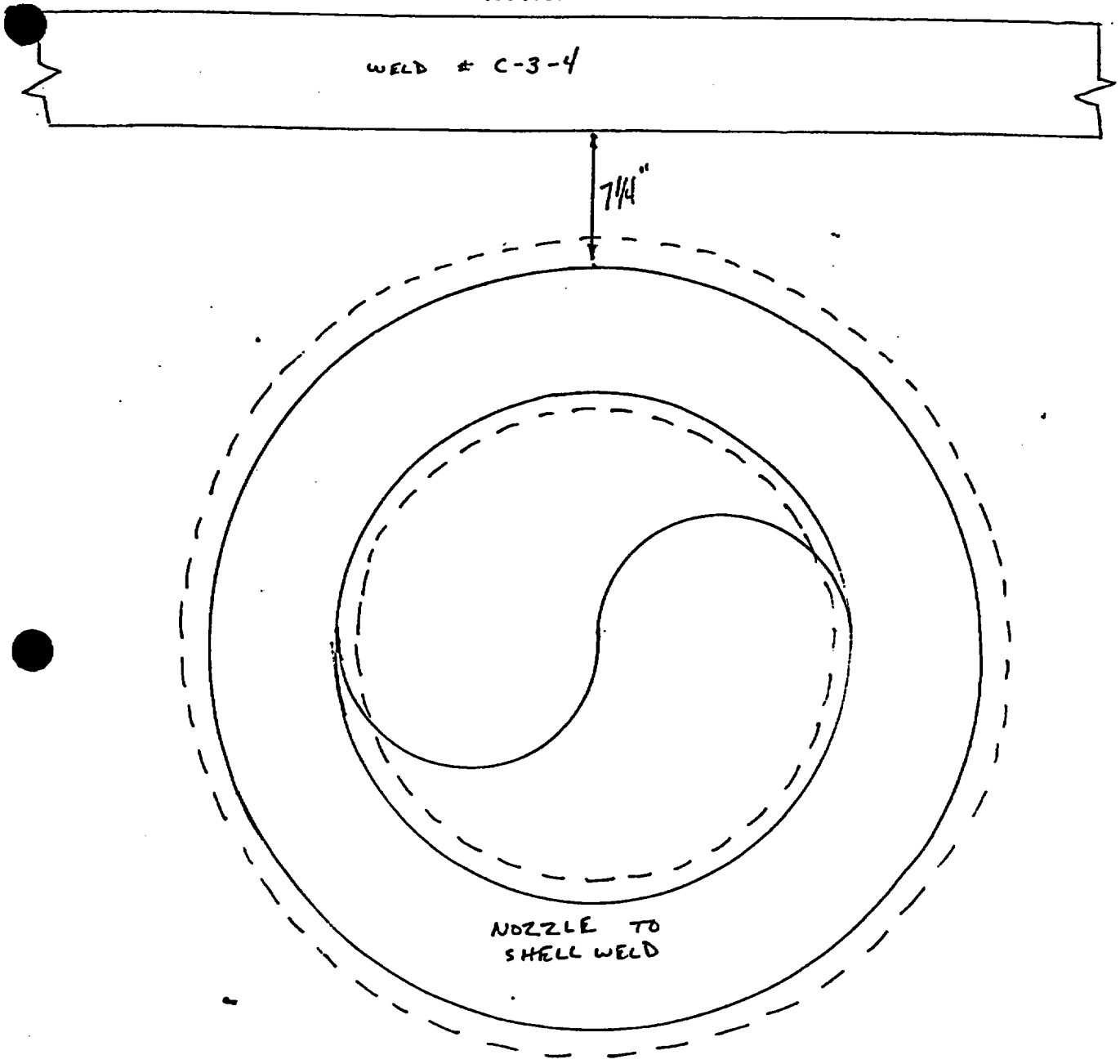
R-143

ULTRASONIC EXAMINATION LIMITATION SKETCH

D.143

00337

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



60° RL RADIAL SCAN WAS LIMITED BY APPROXIMATELY 4.7% DUE TO LIFT OFF ON LOWER TOE OF GIRTH WELD.

Table 1. Browns Ferry Feedwater Nozzle (N4)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	11.25	Weld End R	15.60
Rbore	6	Rnozzle	13
Rbi	3	Rbo	3.75
Rvi	125.6875	Rvo	131.8125

Table 2. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(35 to 67)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(35 to 67)	Vessel	17.27	20.71	9.73	14.44	20
40	±120	Blend	13.45	14.55	7.64	11.35	6

Weld Examination Report

R-144 (Excerpt)

R.144

00351

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Feedwater Nozzle to Vessel Weld
N4D

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area:	34.89 sq. in.
Inner 15% of Weld:	4.37 sq. in.

60° Radial Scan from Shell

Area Examined: 23.99 sq. in.

60° Tangential Scan from Shell

Area Examined: 6.63 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: 4.7%

Percent of 60° RL Scans Completed: (23.99 + 6.63) ÷ 2 = 15.31 ÷ 34.89 x 100 = 43.88% – 4.7% = 39.2%

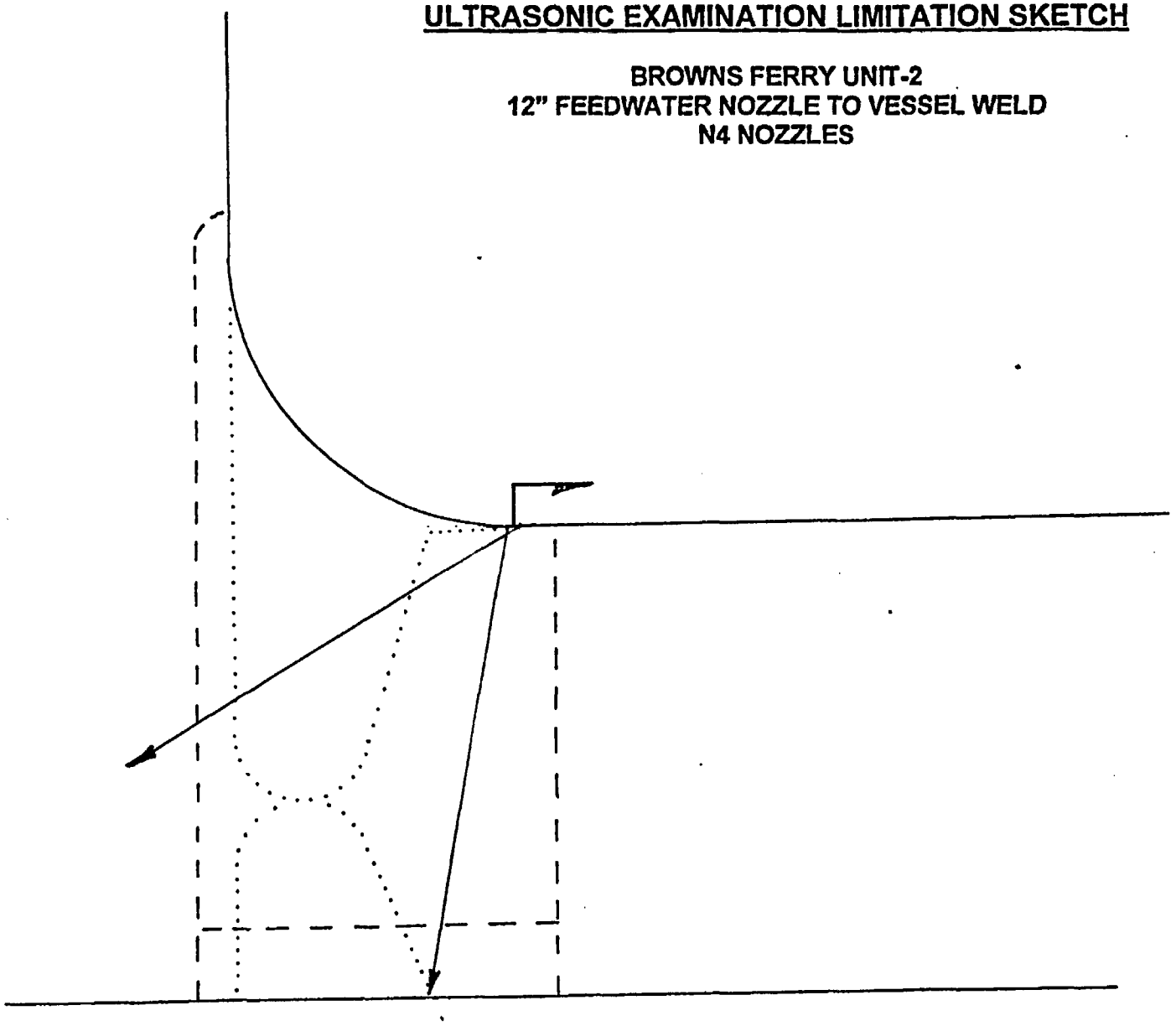
Inner 15% of Weld

Area Examined: 4.37 sq. in.

Total Percent Examination Completed: (4.37 + 6.63 + 23.99) ÷ 2 = 17.50 ÷ 34.89 x 100 = 50.1% – 4.7% = 45.4%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



00352

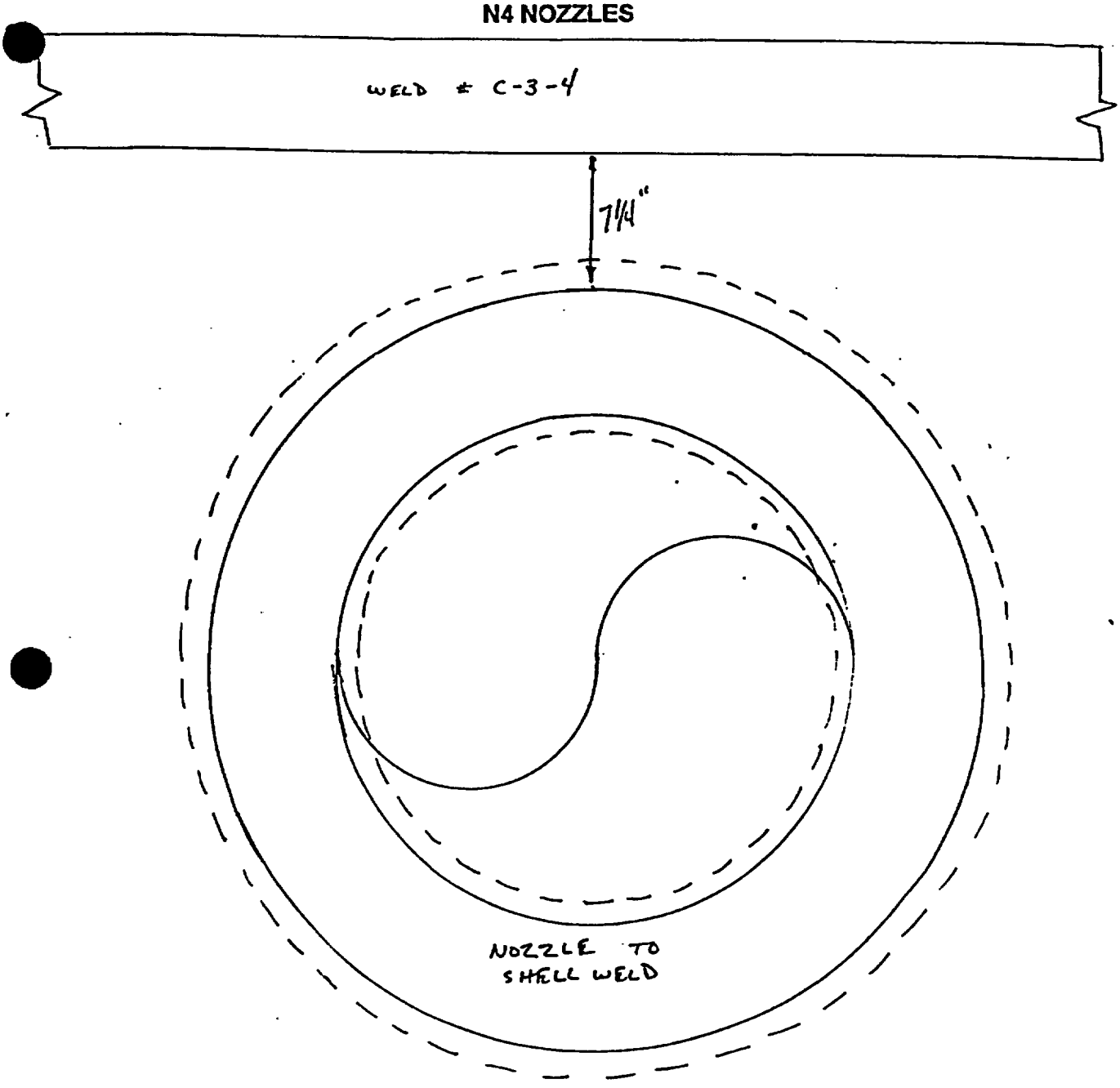
R.144

R-144

ULTRASONIC EXAMINATION LIMITATION SKETCH

00353

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



60° RL RADIAL SCAN WAS LIMITED BY APPROXIMATELY 4.7% DUE TO LIFT OFF ON LOWER TOE OF GIRTH WELD.

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INNER RADIUS EXTENSION (NUREG 0619, ZONE 3)

THERMOCOUPLE ATTACHMENT PAD LIMITATIONS

N4D

Each Thermocouple Attachment Pad limits Inner Radius Extension scan by 2.90". There are 2 Thermocouple Attachment Pads located at approximately 270° on N4A, N4B, N4D and N4F. (See attached Limitation Sketch)

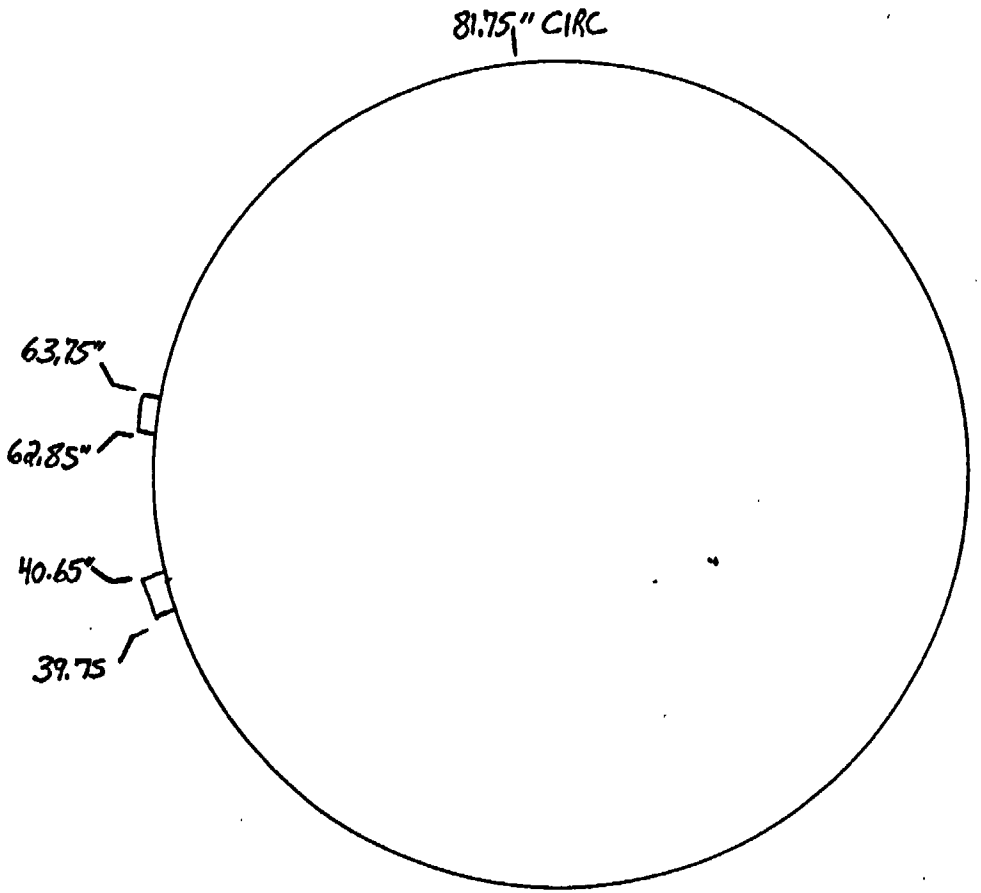
Total Circumferential Measurement of Nozzle Boss: 81.75"

Total Scan Limitation: 2.90" x 2 = 5.80" 5.80" ÷ 81.75" x 100 = 7% Limitation 100% – 7% = 93%

Total Nozzle Inner Radius Extension Coverage = 93%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INSIDE RADIUS EXTENSION (NUREG 0619, ZONE 3)
N4 NOZZLES



THERMOCOUPLE LIMITATION

00365

N-14

Table 1. Browns Ferry Feedwater Nozzle (N4)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	11.25	Weld End R	15.60
Rbore	6	Rnozzle	13
Rbi	3	Rbo	3.75
Rvi	125.6875	Rvo	131.8125

Table 2. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(35 to 67)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(35 to 67)	Vessel	17.27	20.71	9.73	14.44	20
40	±120	Blend	13.45	14.55	7.64	11.35	6

Weld Examination Report

R-145 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Feedwater Nozzle to Vessel Weld
N4E

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area: 34.89 sq. in.
Inner 15% of Weld: 4.37 sq. in.

60° Radial Scan from Shell
Area Examined: 23.99 sq. in.

60° Tangential Scan from Shell
Area Examined: 6.63 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: 4.7%

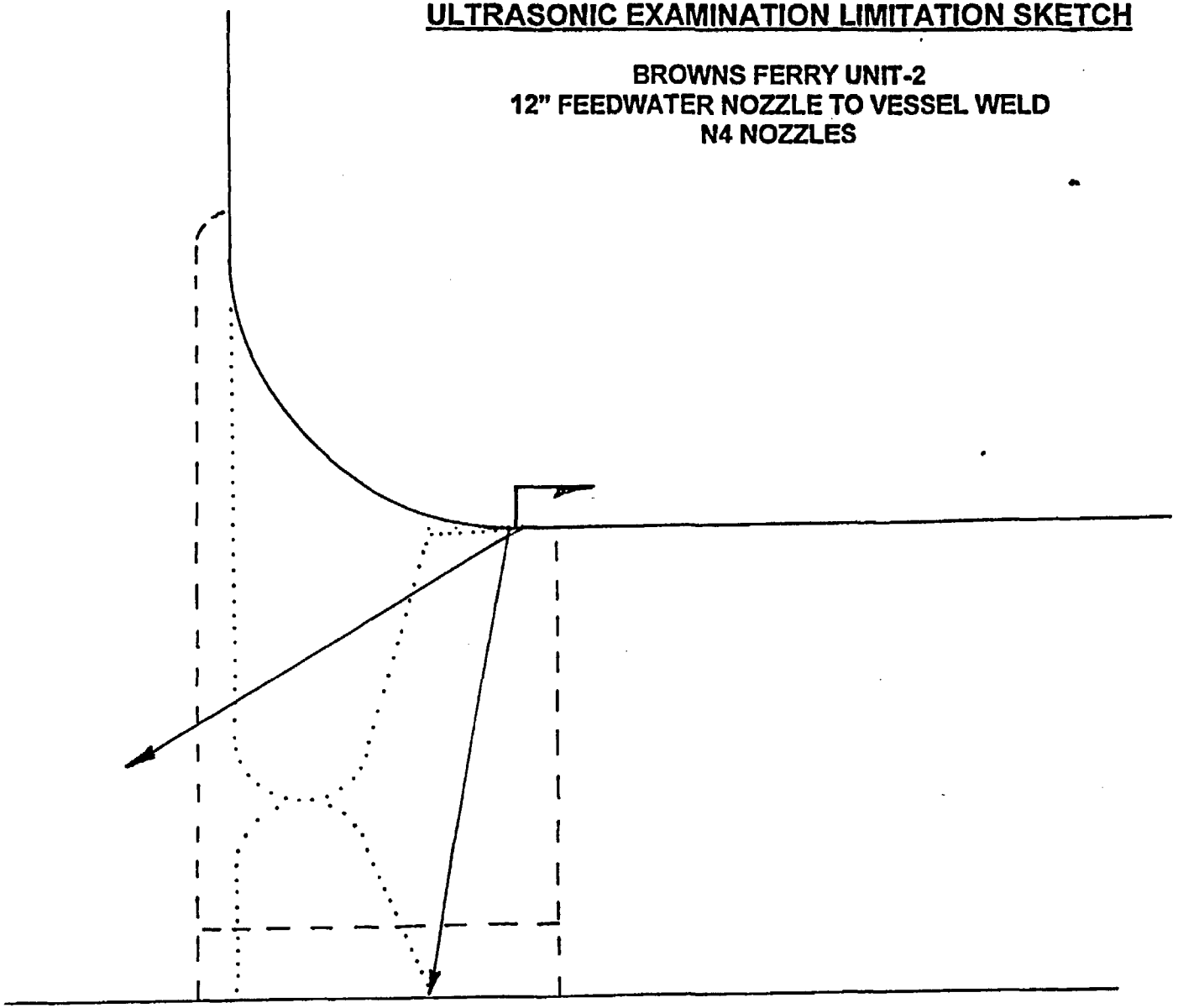
Percent of 60° RL Scans Completed: (23.99 + 6.63) ÷ 2 = 15.31 ÷ 34.89 x 100 = 43.88% – 4.7% = 39.2%

Inner 15% of Weld
Area Examined: 4.37 sq. in.

Total Percent Examination Completed: (4.37 + 6.63 + 23.99) ÷ 2 = 17.50 ÷ 34.89 x 100 = 50.1% – 4.7% = 45.4%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES

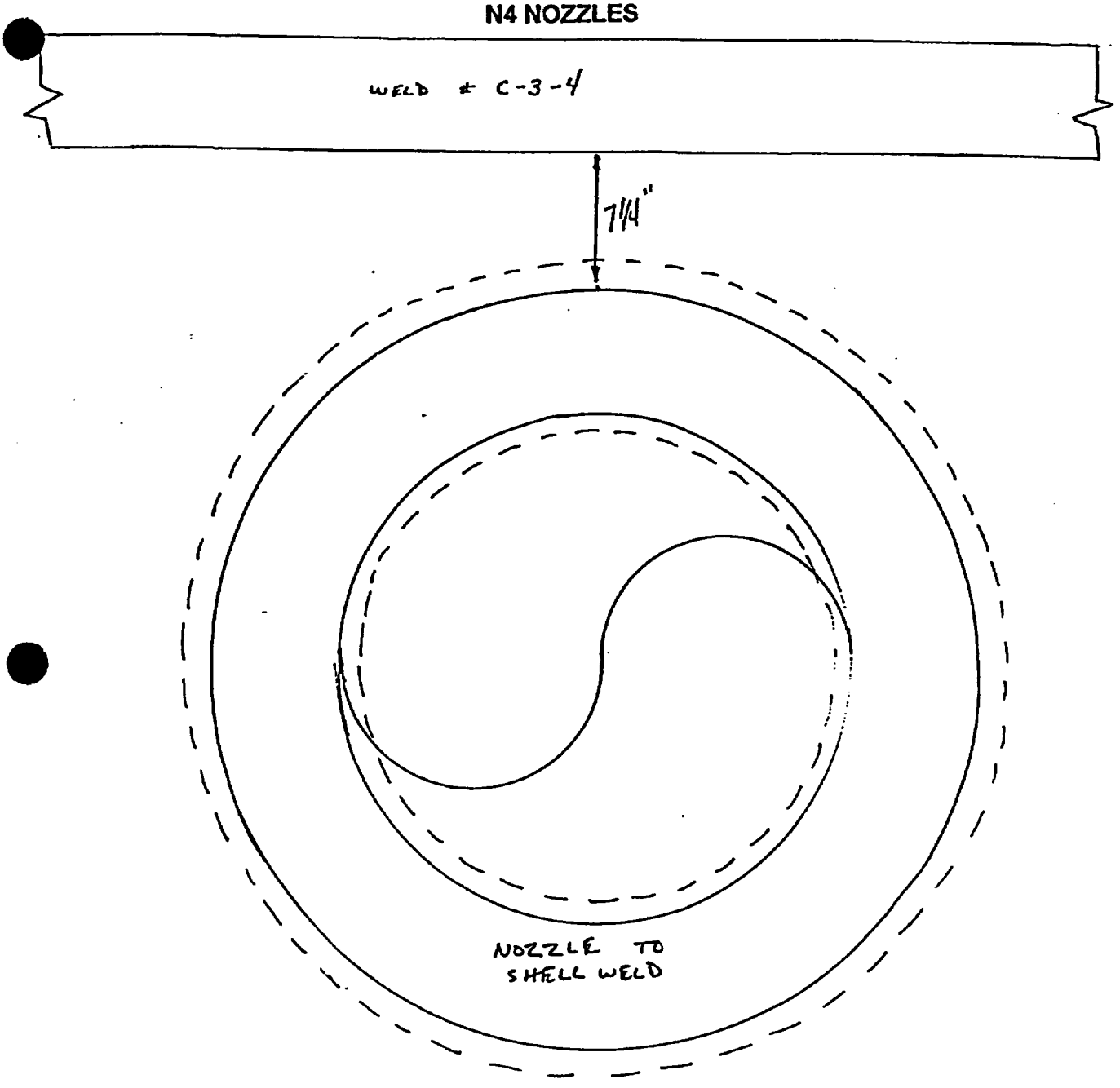


00370 R-145

ULTRASONIC EXAMINATION LIMITATION SKETCH

R·145
00371

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



60° RL RADIAL SCAN WAS LIMITED BY APPROXIMATELY 4.7% DUE TO LIFT OFF ON LOWER TOE OF GIRTH WELD.

Table 1. Browns Ferry Feedwater Nozzle (N4)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	11.25	Weld End R	15.60
Rbore	6	Rnozzle	13
Rbi	3	Rbo	3.75
Rvi	125.6875	Rvo	131.8125

Table 2. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(35 to 67)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(35 to 67)	Vessel	17.27	20.71	9.73	14.44	20
40	±120	Blend	13.45	14.55	7.64	11.35	6

Weld Examination Report

R-146 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

12" Feedwater Nozzle to Vessel Weld
N4F

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area: 34.89 sq. in.
Inner 15% of Weld: 4.37 sq. in.

60° Radial Scan from Shell
Area Examined: 23.99 sq. in.

60° Tangential Scan from Shell
Area Examined: 6.63 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: ***4.7%***

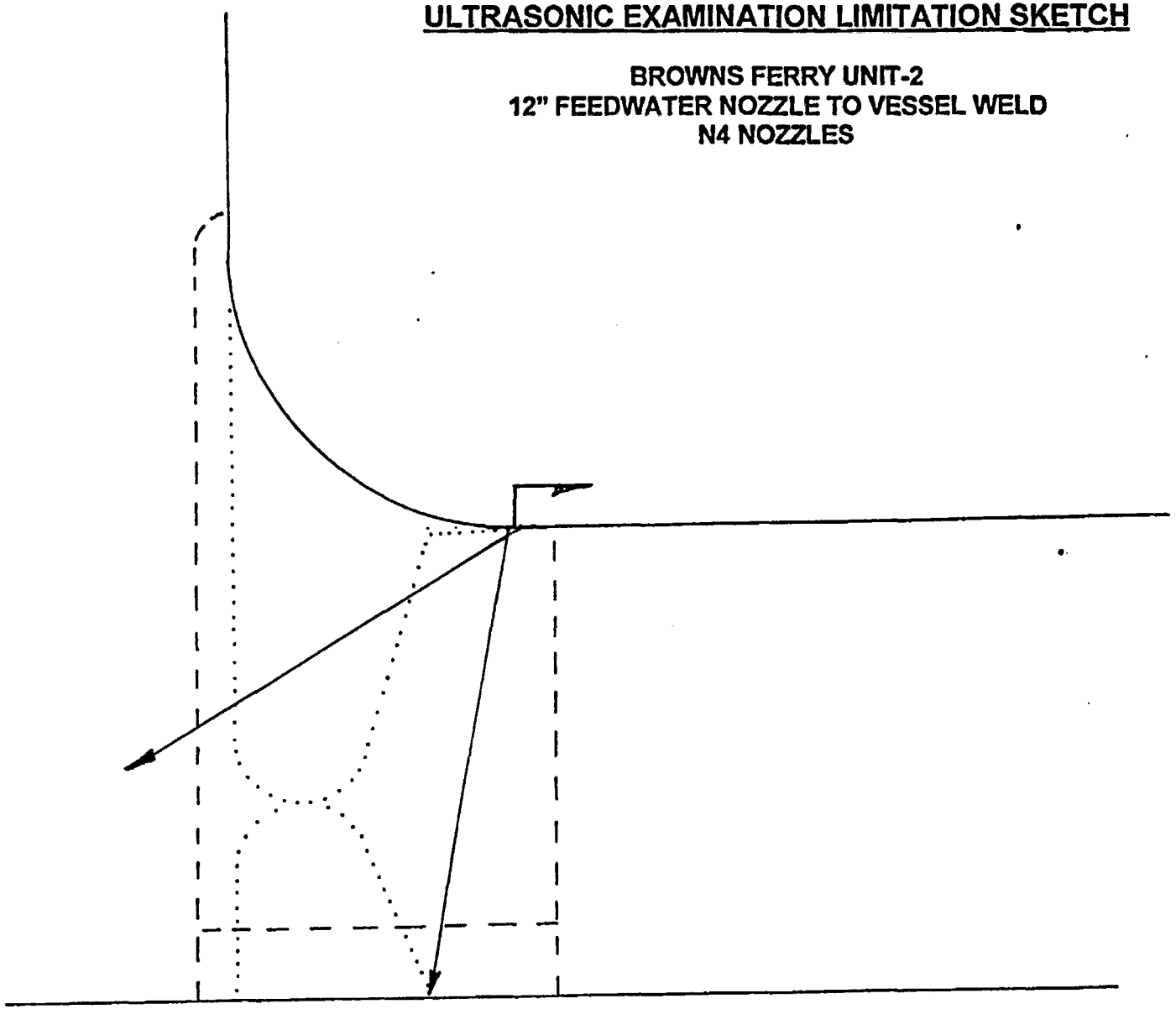
Percent of 60° RL Scans Completed: (23.99 + 6.63) ÷ 2 = 15.31 ÷ 34.89 x 100 = 43.88% – 4.7% = **39.2%**

Inner 15% of Weld
Area Examined: 4.37 sq. in.

Total Percent Examination Completed: (4.37 + 6.63 + 23.99) ÷ 2 = 17.50 ÷ 34.89 x 100 = 50.1% – 4.7% = **45.4%**

ULTRASONIC EXAMINATION LIMITATION SKETCH

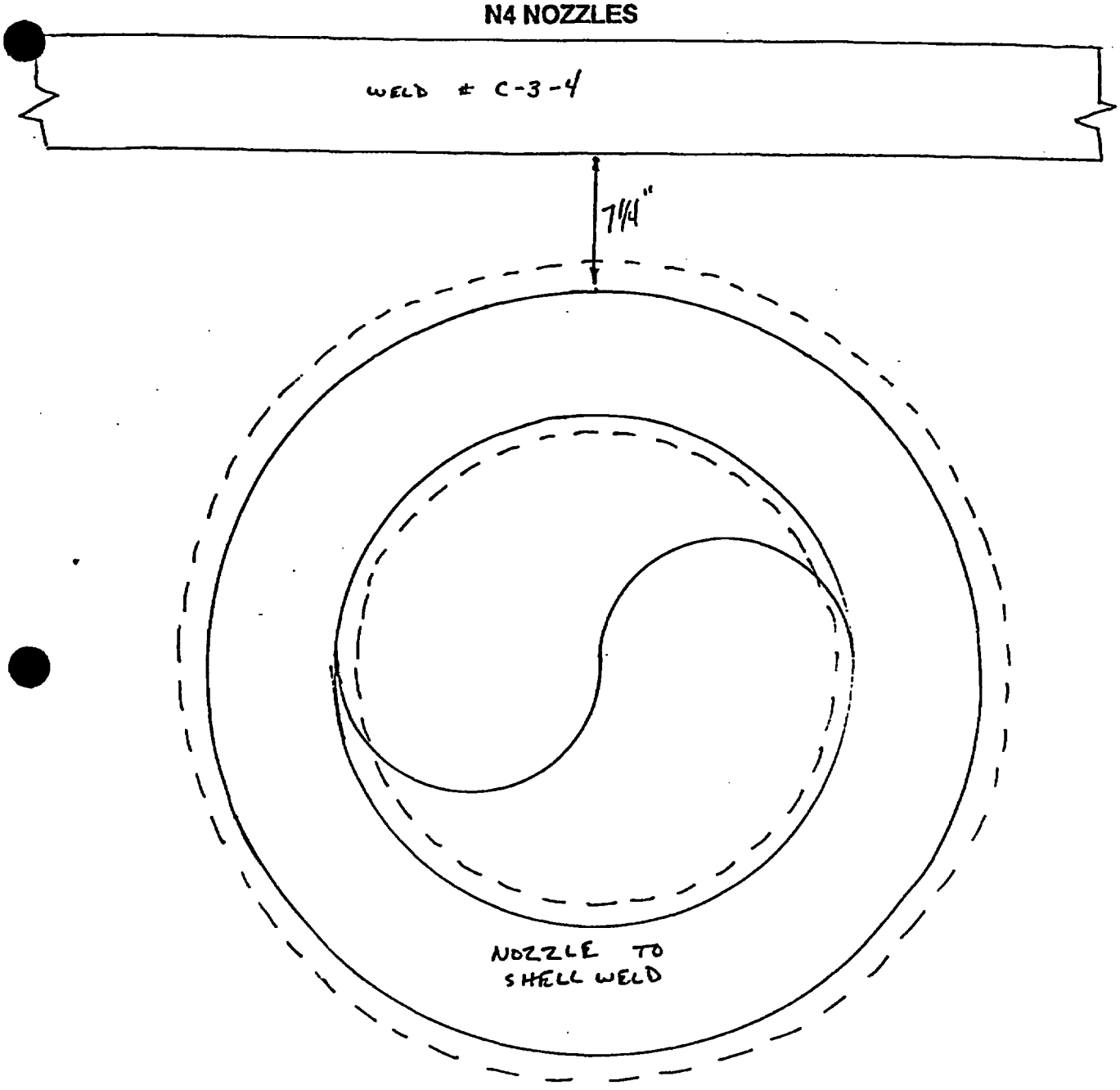
BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



ULTRASONIC EXAMINATION LIMITATION SKETCH

00387 R.146

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE TO VESSEL WELD
N4 NOZZLES



60° RL RADIAL SCAN WAS LIMITED BY APPROXIMATELY 4.7% DUE TO LIFT OFF ON LOWER TOE OF GIRTH WELD.

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INNER RADIUS EXTENSION (NUREG 0619, ZONE 3)

THERMOCOUPLE ATTACHMENT PAD LIMITATIONS

N4F

Each Thermocouple Attachment Pad limits Inner Radius Extension scan by 2.90". There are 2 Thermocouple Attachment Pads located at approximately 270° on N4A, N4B, N4D and N4F. (See attached Limitation Sketch)

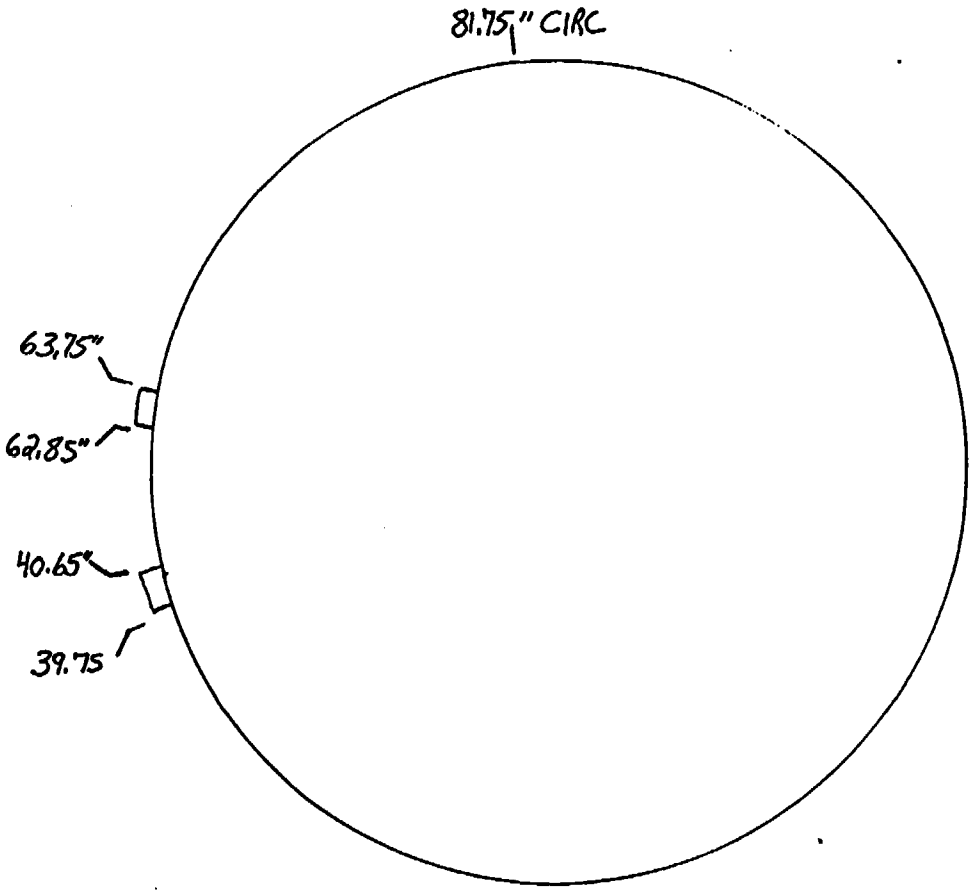
Total Circumferential Measurement of Nozzle Boss: 81.75"

Total Scan Limitation: 2.90" x 2 = 5.80" 5.80" ÷ 81.75" x 100 = 7% Limitation 100% – 7% = 93%

Total Nozzle Inner Radius Extension Coverage = 93%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
12" FEEDWATER NOZZLE INSIDE RADIUS EXTENSION (NUREG 0619, ZONE 3)
N4 NOZZLES



THERMOCOUPLE LIMITATION

00399

N-146

Table 1. Browns Ferry Feedwater Nozzle (N4)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	11.25	Weld End R	15.60
Rbore	6	Rnozzle	13
Rbi	3	Rbo	3.75
Rvi	125.6875	Rvo	131.8125

Table 2. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
60	±(35 to 67)	Vessel	Shear Wave
40	±120	Blend	Shear Wave

Table 3. Spreadsheet Model Techniques for Feedwater Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
60	±(35 to 67)	Vessel	17.27	20.71	9.73	14.44	20
40	±120	Blend	13.45	14.55	7.64	11.35	6

Weld Examination Report

R-165 (Excerpt)

FRAMATOME ANP

ULTRASONIC EXAMINATION LIMITATION REPORT

4" Jet Pump Instrumentation Nozzle to Vessel Weld
N8A

The Ultrasonic examination volume is the Nozzle to Shell weld and adjacent base material for a distance of ½" on each side of the fusion line (Required Examination Area). This includes the outer 85% thickness and the inner 15% thickness as measured from the inside diameter surface. The 60 degree RL, radial scans were used to examine the entire weld examination volume and the tangential scans were used to examine the outer 85% of the weld examination volume. The Zone-1 and Zone-2 examinations were combined to calculate examination coverage.

Ultrasonic examination limitations were encountered from the existing configuration of the nozzle weld blend radius and the adjacent reactor shell weld with the 60 degree RL scans. All other angles used for ultrasonic examination of the inner 15% of the weld yielded 100% coverage. The examination limitations are shown in square inches in order to simplify calculations. See the applicable Ultrasonic Examination Limitation Sketch.

CALCULATIONS

Required Examination Area:	13.43 sq. in.
Inner 15% of Weld:	1.61 sq. in.
	60° Radial Scan from Shell
Area Examined:	12.96 sq. in.
	60° Tangential Scan from Shell
Area Examined:	10.76 sq. in.

Percent of 60° RL Scan Limited from the Adjacent Reactor Shell Weld: 4.8%

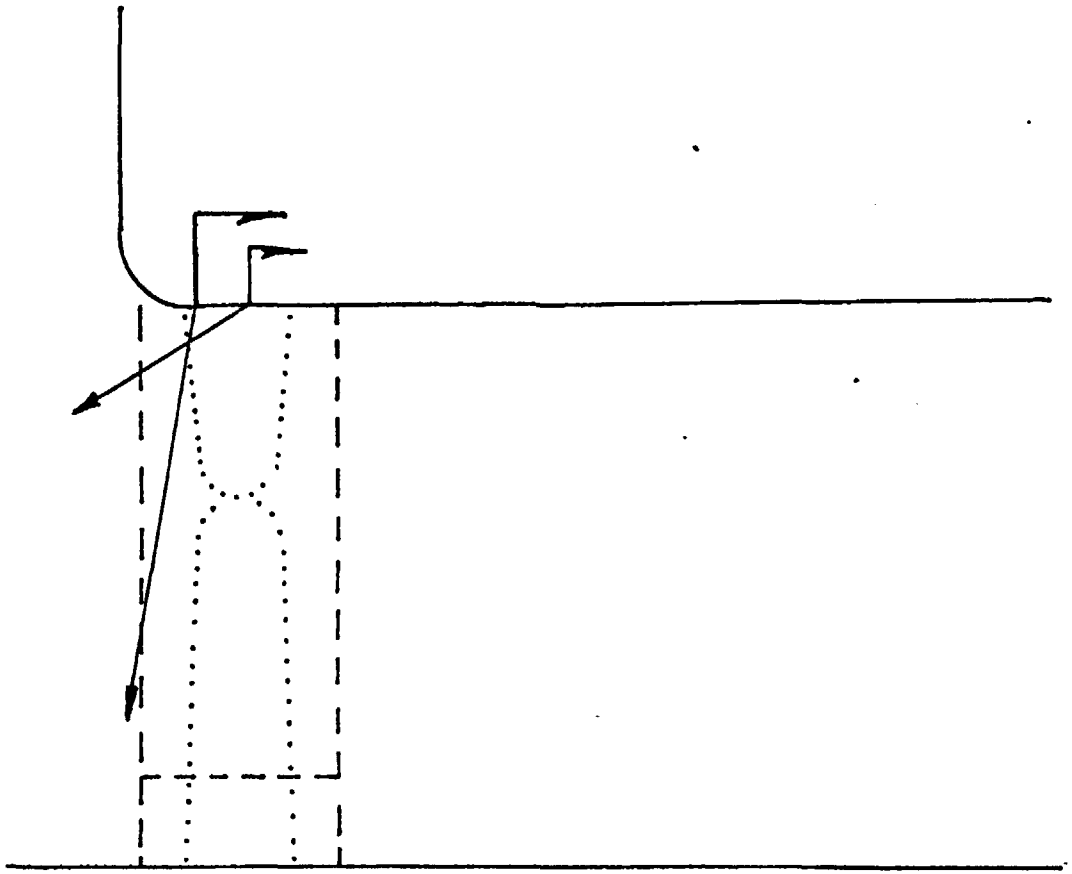
Percent of 60° RL Scans Completed: (12.96 + 10.76) ÷ 2 = 11.86 ÷ 13.43 x 100 = 88.3% – 4.8% = 83.5%

	Inner 15% of Weld
Area Examined:	1.61 sq. in.

Total Percent Examination Completed: (1.61 + 10.76 + 12.96) ÷ 2 = 12.67 ÷ 13.43 x 100 = 94.3% – 4.8% = 89.5%

ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
4" JET PUMP INSTRUMENTATION NOZZLE TO VESSEL WELD
N8A NOZZLE



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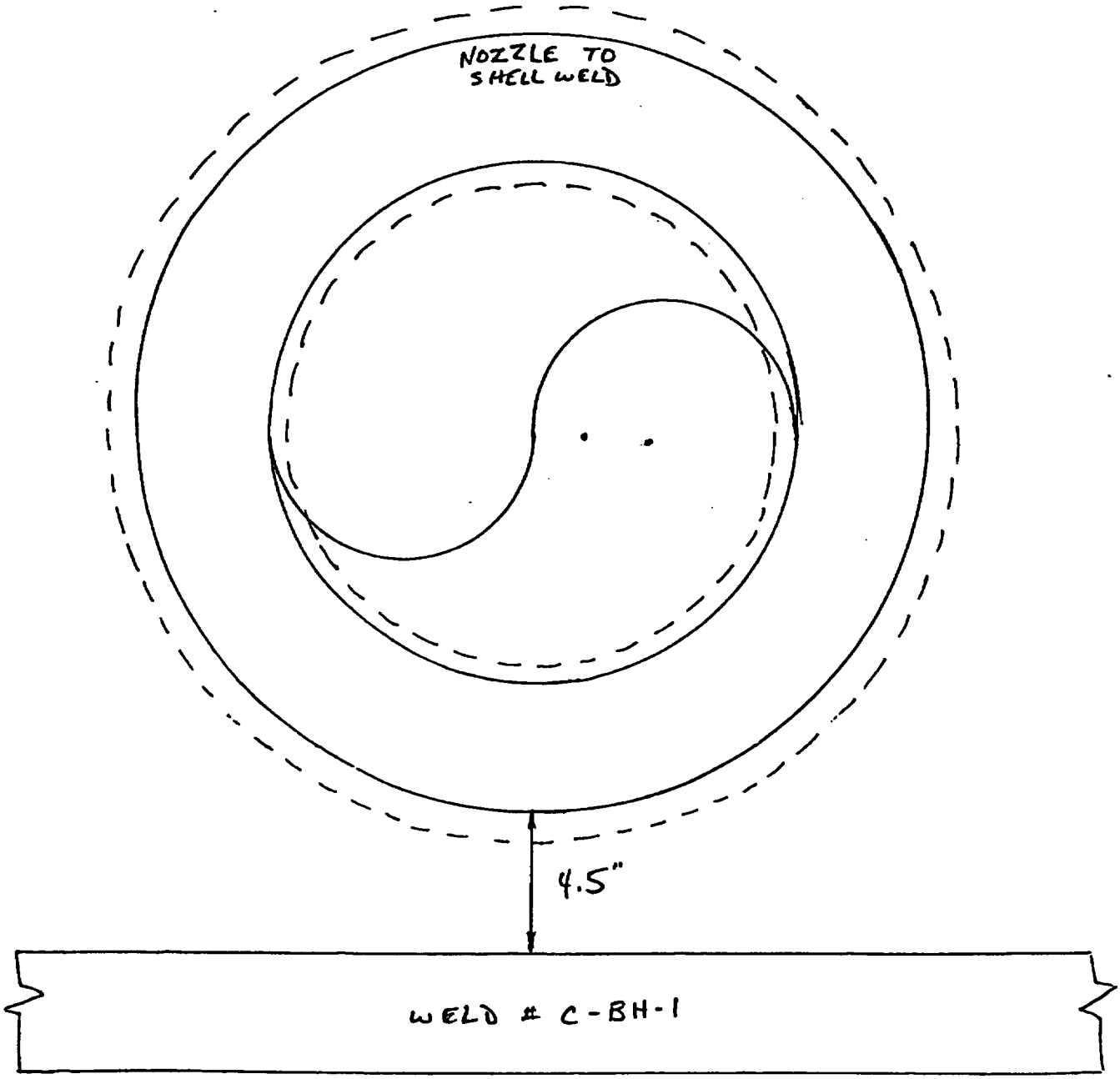
ULTRASONIC EXAMINATION LIMITATION SKETCH

BROWNS FERRY UNIT-2
4" JET PUMP INSTRUMENTATION NOZZLE TO VESSEL WELD
N8A NOZZLE



60° RL RADIAL SCAN WAS LIMITED BY 4.8% (APPROXIMATELY)
DUE TO LIFT OFF ON UPPER TOE OF GIRTH WELD.

Table 1. Browns Ferry Jet Pump Instrumentation Nozzle (N8)
Geometry Inputs to Spreadsheet Model for Nozzle-to-Shell Weld Examination

Inside Surface Dimensions	(inches)	Outside Surface Dimensions	(inches)
Weld Start R	3.3125	Weld End R	4.6875
Rbore	2.094	Rnozzle	4.125
Rbi	0.75	Rbo	0.75
Rvi	125.6875	Rvo	131.9375

Table 2. Spreadsheet Techniques for Jet Pump Instrumentation Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
50	±(15 to 45)	Vessel	Shear Wave

Table 3. Spreadsheet Techniques for Jet Pump Instrumentation Nozzle-to-Shell Weld.

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
50	±(15 to 45)	Vessel	6.51	10.39	7.79	10.75	8