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

May 4, 2006

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. 50-296
Tennessee Valley Authority)

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 3 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI, INSERVICE INSPECTION (ISI) PROGRAM, SECOND TEN-YEAR INSPECTION INTERVAL - REQUEST FOR RELIEF 3-ISI-7, REVISION 1 - RESPONSE TO NRC INFORMAL REQUEST FOR ADDITIONAL INFORMATION (TAC NOS. MC6314, MC6386, AND MC6387)

This letter provides TVA's response to an informal NRC request for additional information regarding BFN Unit 3, ASME Section XI Inservice Inspection (ISI) Program, request for relief 3-ISI-7, Revision 1. This request for relief was submitted, with requests for relief 3-ISI-12, and 3-ISI-19, by TVA letter dated March 4, 2005, for NRC review and approval.

During its review of the BFN requests for relief the NRC staff identified questions by letter dated August 3, 2005. TVA provided its response to the NRC request for additional information by letter dated September 26, 2005. Subsequently, the NRC identified additional questions regarding request for relief 3-ISI-7, Revision 1. These questions were transmitted by NRC informally to TVA and discussed in a teleconference on January 25, 2006.

Request for relief 3-ISI-7, Revision 1, addressed ten (10) Reactor Pressure Vessel (RPV) nozzle-to-vessel full penetration welds and one (1) nozzle inner radius. The

A047

design configuration of the RPV nozzle-to-vessel weld and inner-radius precluded a 100 percent ultrasonic (UT) examination of the required volume for the full penetration welds of the nozzles.

The enclosure to this letter contains the specific NRC questions and the corresponding TVA response.

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

Sincerely,

William D. Crouch

William D. Crouch
Manager of Licensing
and Industry Affairs

cc: See Page 3

Enclosure
cc (Enclosure):
(Via NRC Electronic Distribution)

Mr. Malcolm T. Widmann, Branch Chief
U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, Georgia 30303-8931

NRC Resident Inspector
Browns Ferry Nuclear Plant
10833 Shaw Road
Athens, Alabama 35611-6970

Ms. Margaret Chernoff, Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
(MS 08G9)
11555 Rockville Pike
Rockville, Maryland 20852-2739

Ms. Eva A. Brown, Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
(MS 08G9)
11555 Rockville Pike
Rockville, Maryland 20852-2739

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 3
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI,
INSERVICE INSPECTION (ISI) PROGRAM
(SECOND TEN-YEAR INSPECTION INTERVAL)

REQUEST FOR RELIEF 3-ISI-7, REVISION 1
RESPONSE TO NRC INFORMAL REQUEST FOR ADDITIONAL INFORMATION

This enclosure provides TVA's response to an informal NRC request for additional information regarding BFN Unit 3, ASME Section XI Inservice Inspection (ISI) Program, request for relief 3-ISI-7, Revision 1. This request for relief was submitted, along with requests for relief 3-ISI-12, and 3-ISI-19, by TVA letter dated March 4, 2005, for NRC review and approval.

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Listed below are the specific NRC questions and the corresponding TVA response.

1.0, Request for Relief 3-ISI-7, Revision 1

NRC Request 1.1

When discussing surface finish, describe how the arithmetical average (AA) relates to the root mean square (RMS) average.

TVA Response to NRC Request 1.1

Surface roughness values are typically expressed in microinch units. A microinch is one-millionth of an inch (0.000001). Surface roughness measurements expressed as an arithmetic average (AA) deviation from the mean surface are somewhat less than the root mean square (RMS) average deviation. AA roughness is obtained by adding all measurements in the "y" direction without regard to sign and dividing the sum by the number of measurements added. RMS roughness is obtained by adding the square of all of the measurements in the "y" direction, taking the square root of the sum and then dividing by the number of measurements. Roughness measuring instruments calibrated to give RMS values will read approximately 11 percent higher for a surface than instruments calibrated for AA values. The conclusion is a RMS reading of the same value as an AA reading would represent a smoother surface. For example, a 250 AA finish equates to a 277 RMS finish.

NRC Request 1.2

Provide the EPRI modeling report for the BFN Unit 3 reactor pressure vessel nozzle N10-1R.

TVA Response to NRC Request 1.2

The EPRI modeling report for BFN Unit 3 RPV nozzle N10-1R is provided in attachment A of this enclosure.

NRC Request 1.3

For the nozzles in request for relief 3-ISI-7, Revision 1, please address how the zero-degree L-waves affects the ultrasonic scan coverage results.

TVA Response to NRC Request 1.3

Within the documentation provided in BFN request for relief 3-ISI-7, examination data was provided for the following RPV Nozzle to Vessel (NV) and nozzle Inner Radius (IR) welds:

N1B-NV, N2A-NV, N2C-NV, N2E-NV, N3A-NV, N4A-NV, N4F-NV, N5B-NV, N7-NV, N9-NV, and N-10 IR

These weld examinations, with the exception of nozzle N-10 IR, were performed prior to the PDI Program implementation date of November 22, 2002, for RPV Nozzles and Dissimilar Metal welds. The Code examination criteria defined in ASME Section XI 1995 Edition, 1996 Addenda, Appendix I, paragraph I-2400 applied to those RPV Nozzle welds (i.e., the use of ASME Section V, Article 4). The scanning requirements of Section V, Article 4 required a straight beam (zero-degree) scan for planar reflectors as defined in paragraph T441.1.2(a). As a result of this requirement, the zero-degree examination was factored into the code coverage calculation.

RPV Nozzle weld N-10 IR examination was performed after the implementation the PDI Program for RPV Nozzles and Dissimilar Metal Welds. The qualified examination technique does not include a zero-degree scan and was not factored into the calculation for code coverage.

ATTACHMENT A

EPRI Modeling Report for BFN Nozzle N10-IR

Browns Ferry Standby Liquid Control Nozzle (N10) Inner Radius Examination

Douglas E. MacDonald
EPRI NDE Center

Introduction

This report describes the work performed by the EPRI NDE Center to assist Browns Ferry in developing outside surface examination techniques for the standby liquid control nozzle inner corner radius region. The inspection is to be performed by Framatome. The necessary geometric inputs to the EPRI spreadsheet model [1] are listed for the nozzle and cross sectional plots are provided. The technique design curves developed by the model are given together with the techniques chosen for the nozzle. Tabular and graphical information on the technique maximum and minimum probe radial position and metal path are provided. The combined coverage or minimum misorientation angle achieved by the chosen techniques is given, as well as, the associated metal path and beam angle at the flaw. This report addresses Browns Ferry request to limit the radial extent of the vessel shell examinations.

Detection

Table 1 gives the necessary geometric inputs to the NDE Center spreadsheet model for the Browns Ferry standby liquid control nozzle [2]. Figure 1 shows the geometric parameters, which define the nozzle. The ASME Section XI Class I examination volume is also indicated in Figure 1.

Table 1. Browns Ferry Standby Liquid Control Nozzle (N10)
Geometry Inputs to Spreadsheet Model

Inside Surface Dimensions	(degrees)/ (inches)	Outside Surface Dimensions	(degrees)/ (inches)
Rbore	1.1719	Rnozzle	1.5625
Rbi	0.75	Rbo	0.75
Rvi	125.6875	Rvo	131.9375

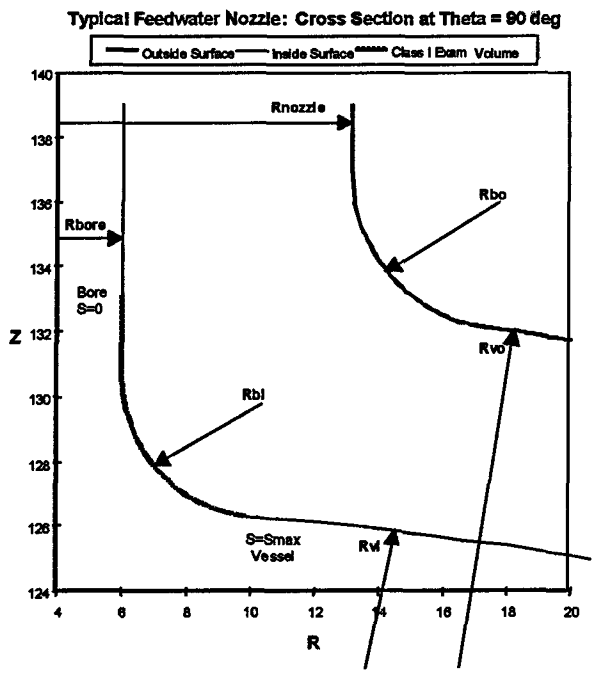


Figure 1. Cross Section of Nozzle Defining Class I Examination Volume.

Figure 2 is a plot of the probe beam angle versus the probe skew angle for all values of surface distance, S at the fixed azimuth, θ = 0° (the standby liquid control nozzle is axi-symmetric). The curve in Figure 2 gives the information regarding the probe angles and probe skews needed to obtain a 50° corner trap response everywhere in the inner radius examination zone of the standby liquid control nozzle, the technique design curve.

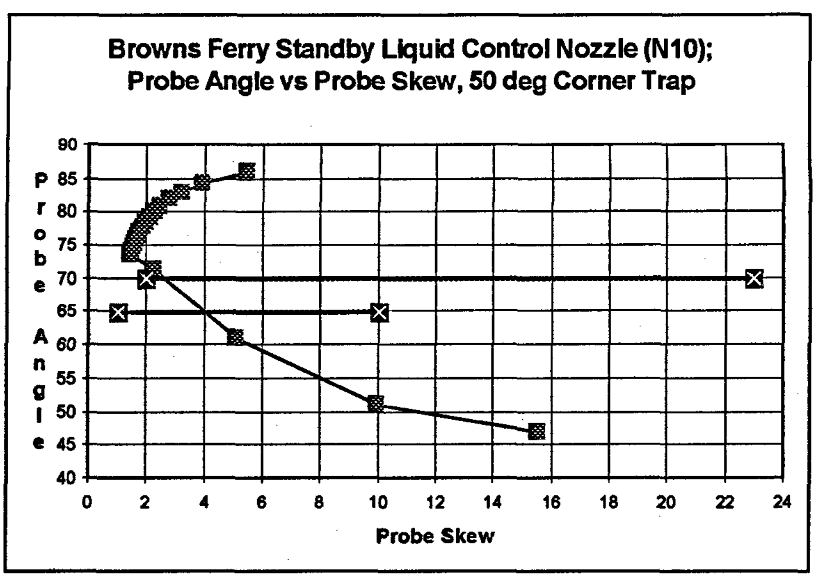
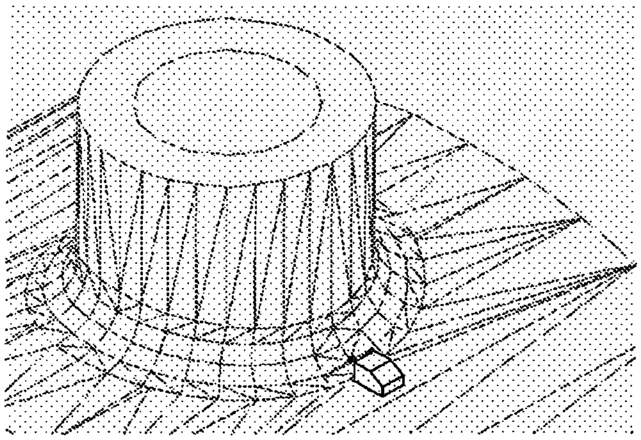
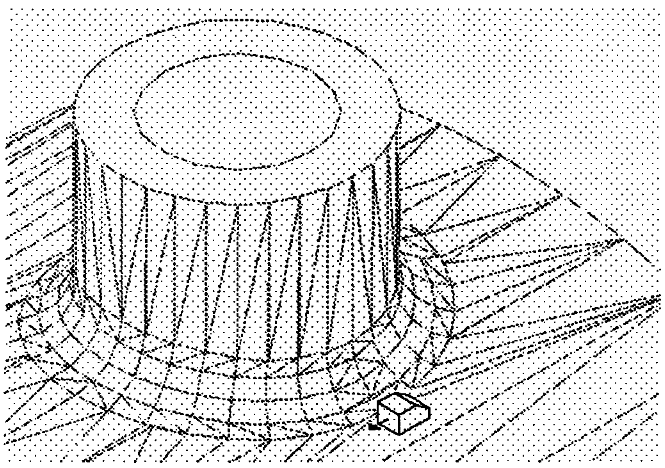


Figure 2. Browns Ferry Standby Liquid Control Nozzle (N10):
Probe Angle vs. Probe Skew; 50° Corner Trap, Technique Design Curve.

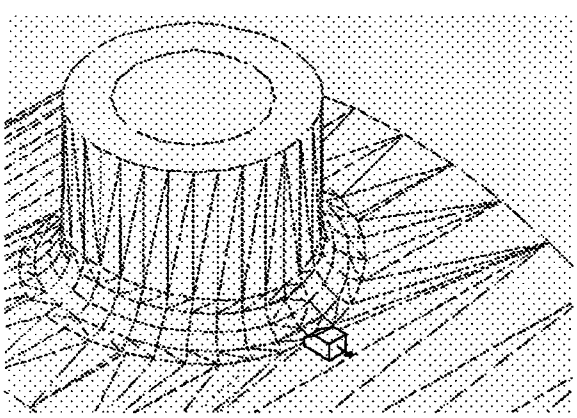
The convention adopted here for probe skew angles has 0° aligned with the nozzle axis with the beam pointed toward the nozzle; 90°, pointed circumferentially around the nozzle; and 180°, again aligned with the nozzle axis but pointed toward the vessel (see Figure 3).



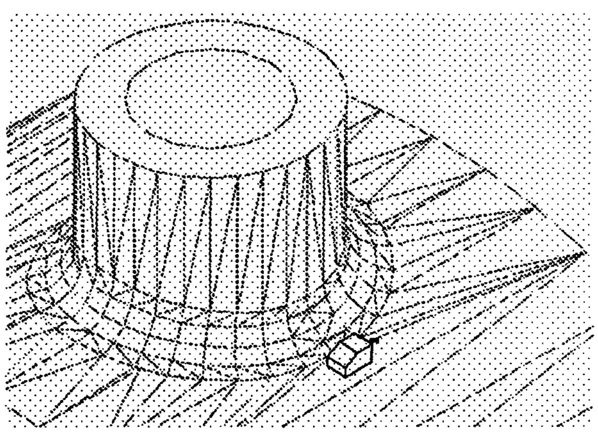
a) Probe Skew = 0°



b) Probe Skew = +90°



c) Probe Skew = 180°



d) Probe Skew = -90°

Figure 3. Definition of Probe Skew Angle.

The EPRI spreadsheet model detection techniques to examine the Browns Ferry standby liquid control nozzle involve scanning from the outer vessel shell. Table 2 gives the probe beam and skew angles, scan surface, and the mode of propagation.

Table 2. Spreadsheet Model Detection Techniques for Browns Ferry Standby Liquid Control Nozzle (N10).

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
70	±(2 to 23)	Vessel	Shear Wave
65	±(1 to 10)	Vessel	Shear Wave

Figure 2 shows these detection techniques in relation to the probe angle versus probe skew curve. These EPRI spreadsheet examination detection techniques are summarized again in Table 3 together with the corresponding scan surfaces, minimum and maximum probe radial positions, minimum and maximum metal paths, and maximum misorientation angle.

Table 3. Spreadsheet Model Detection Techniques for Browns Ferry Standby Liquid Control Nozzle (N10).

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
70	±(2 to 23)	Vessel	2.94	15.54	2.30	16.07	18
65	±(1 to 10)	Vessel	13.85	15.54	14.14	16.07	14

Figure 4 shows the minimum and maximum probe radial positions and the portion of the examination volume covered by the vessel shell detection technique, 70/(2 to 23)v, for probes scanned at the azimuth angle of 0°.

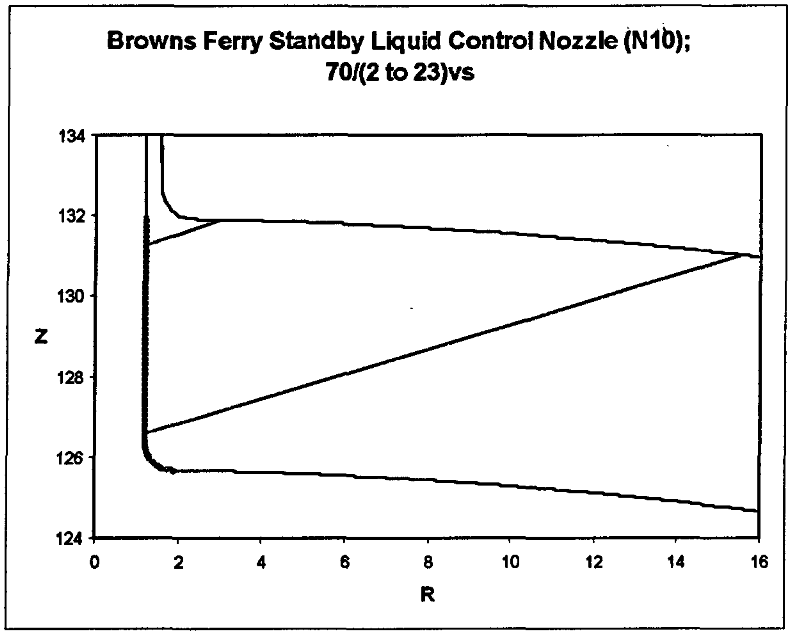


Figure 4. Browns Ferry Standby Liquid Control Nozzle (N10): Probe Scan Limits and Examination Coverage for Vessel Shell Detection Technique, 70/(2 to 23)v.

Figure 5 shows the minimum and maximum probe radial positions and the portion of the examination volume covered by the vessel shell detection technique, 65/(1 to 10)v, for probes scanned at the azimuth angle of 0°.

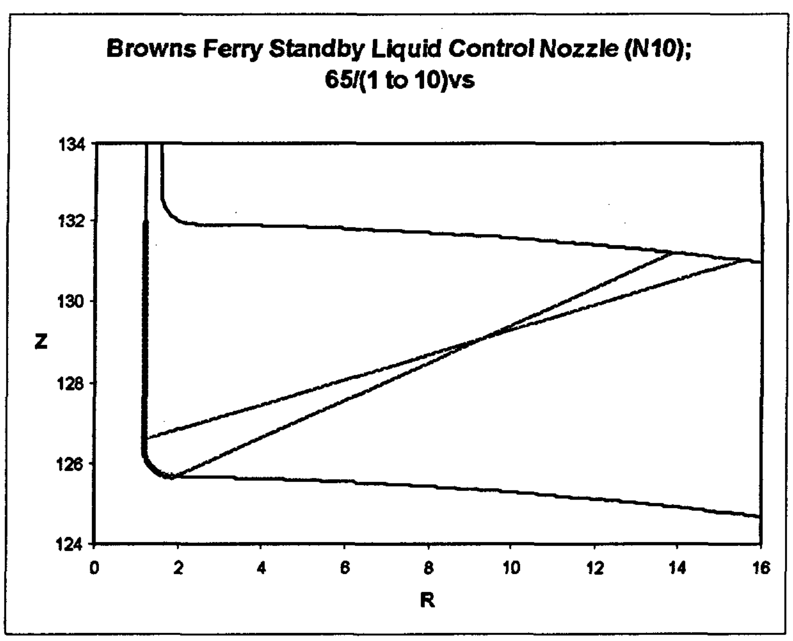


Figure 5. Browns Ferry Standby Liquid Control Nozzle (N10): Probe Scan Limits and Examination Coverage for Vessel Shell Detection Technique, 65/(1 to 10)v.

In viewing Figures 4 and 5, each of these probe/skew angle combinations is effective within some subset of the examination volume and ineffective in other areas. The vessel shell detection technique, 70/(2 to 23)v is effective for flaws on the bore, the vessel shell detection technique, 65/(1 to 10)v is effective for flaws on the inner blend radius.

Figure 6 shows the combined coverage (misorientation angle) for nozzle inner radius examination volume for the vessel shell detection techniques, 70/(2 to 23)v and 65/(1 to 10)v.

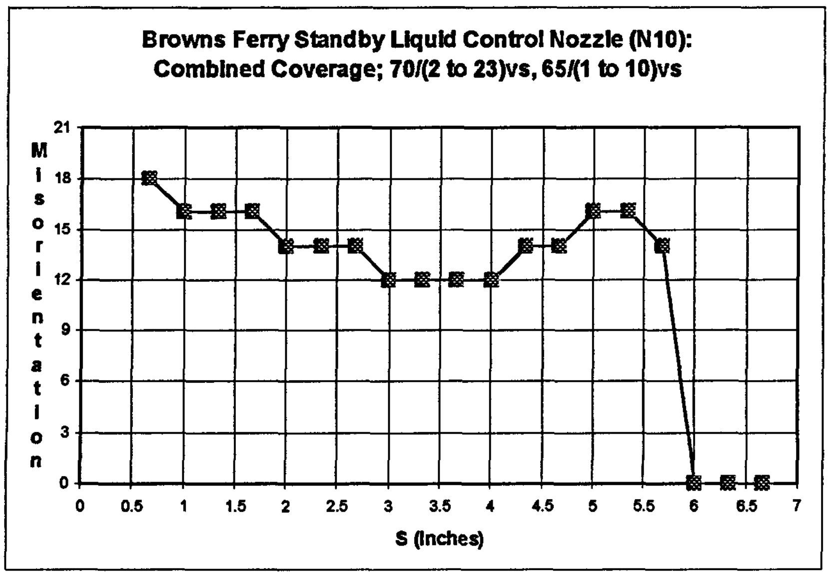


Figure 6. Browns Ferry Standby Liquid Control Nozzle: Coverage Plot, Vessel Shell Detection Techniques; 70/(2 to 23)v and 65/(1 to 10)vs.

Figure 7 shows the plot of the metal path to the points on the examination volume for the coverage shown in Figure 6.

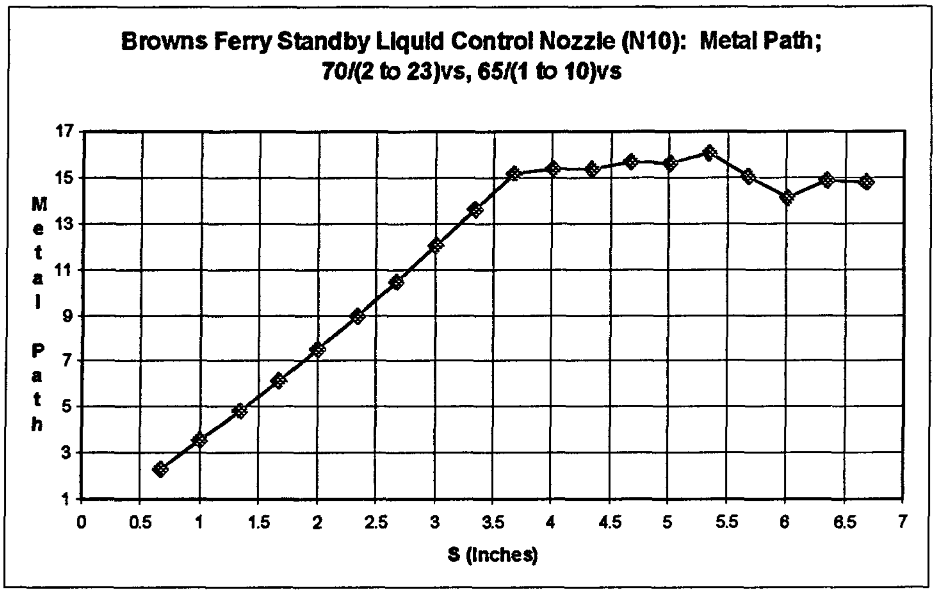


Figure 7. Browns Ferry Standby Liquid Control Nozzle (N10): Metal Path Plot; Union of Vessel Shell Detection Techniques; 70/(2 to 23)v, and 65/(1 to 10)v.

Figure 8 shows the plot of the beam angle at the flaw (nominal inspection angle) for the points on the examination volume for the coverage shown in Figure 6.

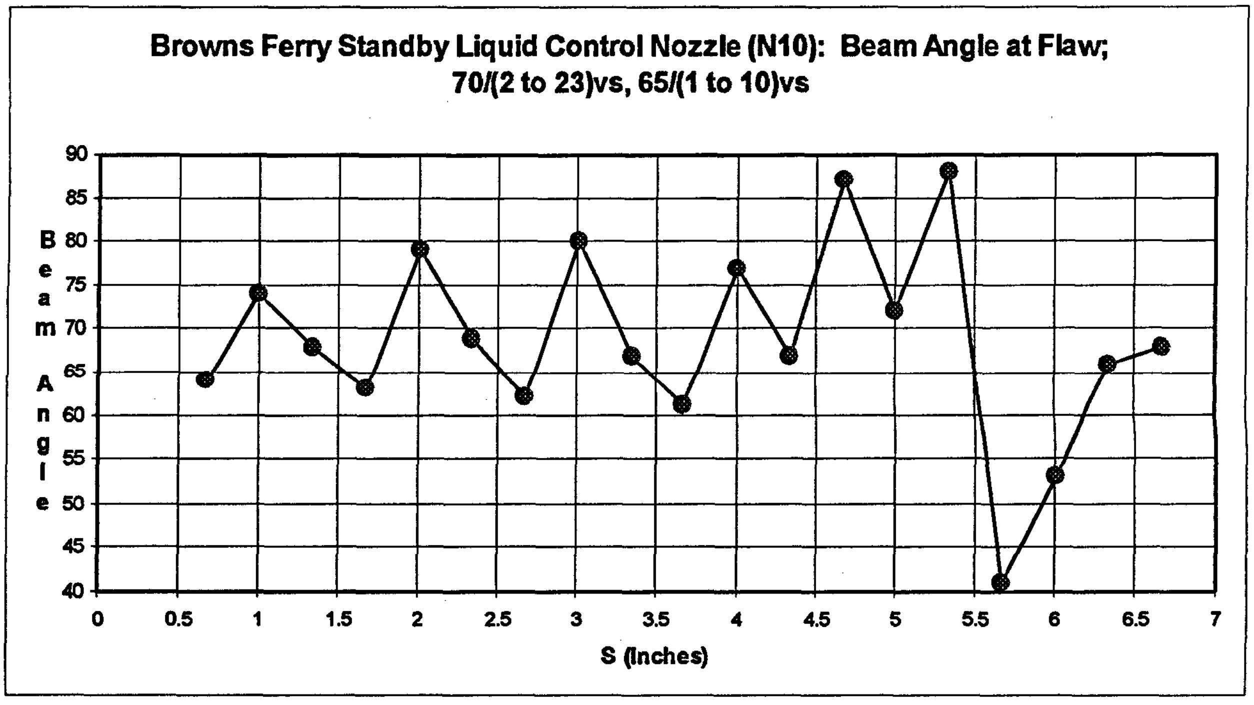


Figure 8. Browns Ferry Standby Liquid Control Nozzle: Beam Angle at Flaw Plot; Union of Vessel Shell Detection Techniques; 70/(2 to 23)v, and 65/(1 to 10)v.

Sizing

The EPRI spreadsheet model sizing techniques to examine the Browns Ferry standby liquid control nozzle involve scanning from the outer vessel shell. Table 4 gives the probe beam and skew angles, scan surface, and the mode of propagation.

Table 4. Spreadsheet Model Sizing Techniques for Browns Ferry Standby Liquid Control Nozzle (N10).

Probe Angle	Probe Skew	Scan Surface	Mode of Propagation
70	±(2 to 21)	Vessel	Shear Wave
65	±(1 to 7)	Vessel	Shear Wave
45	±(6 to 20)	Vessel	Shear Wave

Figure 9 shows these sizing techniques in relation to the probe angle versus probe skew curve. These EPRI spreadsheet examination sizing techniques are summarized again in Table 5 together with the corresponding scan surfaces, minimum and maximum probe radial positions, minimum and maximum metal paths, and maximum misorientation angle.

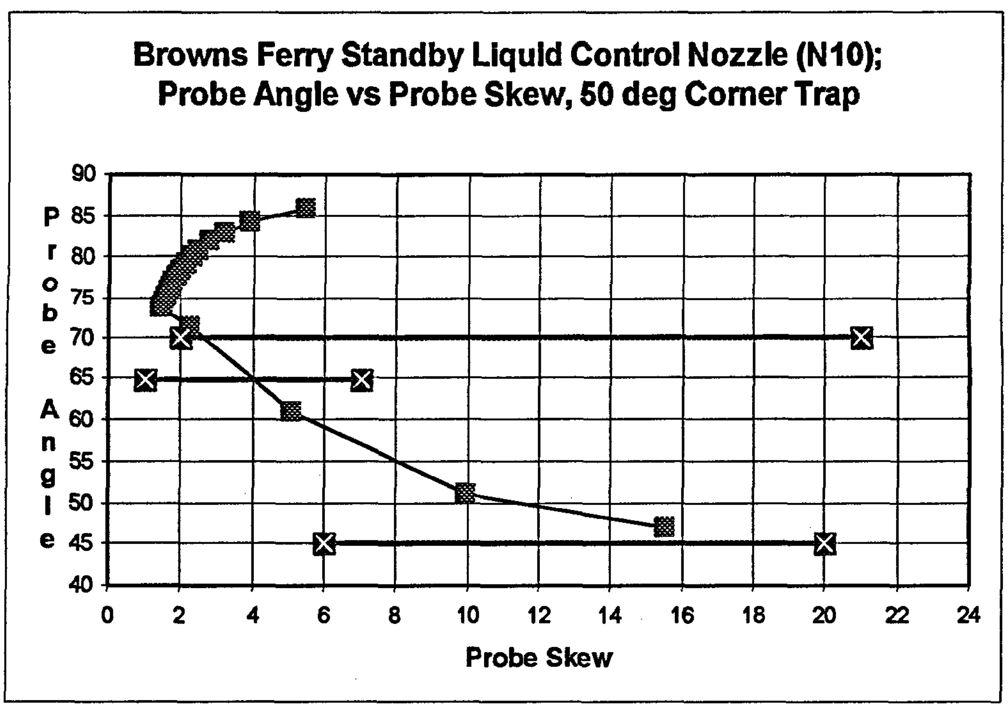


Figure 9. Browns Ferry Standby Liquid Control Nozzle (N10): Probe Angle vs. Probe Skew; 50° Corner Trap, Technique Design Curve.

Table 5. Spreadsheet Model Sizing Techniques for Browns Ferry Standby Liquid Control Nozzle (N10).

Probe Angle	Probe Skew	Scan Surface	Min R	Max R	Min MP	Max MP	Max Misorientation
70	±(2 to 21)	Vessel	3.00	15.52	2.25	15.35	20
65	±(1 to 7)	Vessel	13.86	15.50	14.14	15.45	20
45	±(6 to 20)	Vessel	6.43	7.99	8.64	9.12	0

Figure 10 shows the minimum and intermediate probe radial positions and the portion of the examination volume covered by the vessel shell sizing technique, 70/(2 to 21)v, for probes scanned at the azimuth angle of 0°.

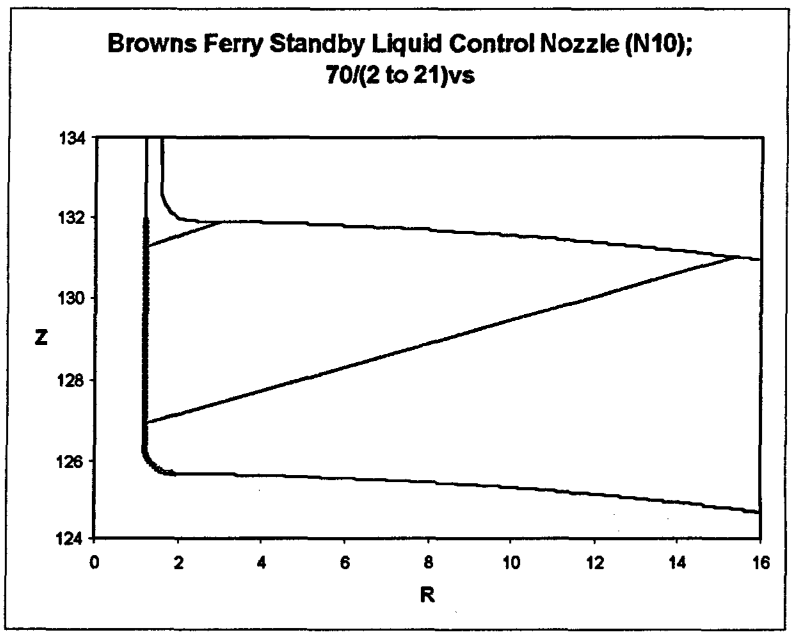


Figure 10. Browns Ferry Standby Liquid Control Nozzle (N10): Probe Scans and Examination Coverage for Vessel Shell Sizing Technique, 70/(2 to 21)v.

Figure 11 shows the minimum and intermediate probe radial positions and the portion of the examination volume covered by the vessel shell sizing technique, 65/(1 to 7)v, for probes scanned at the azimuth angle of 0°.

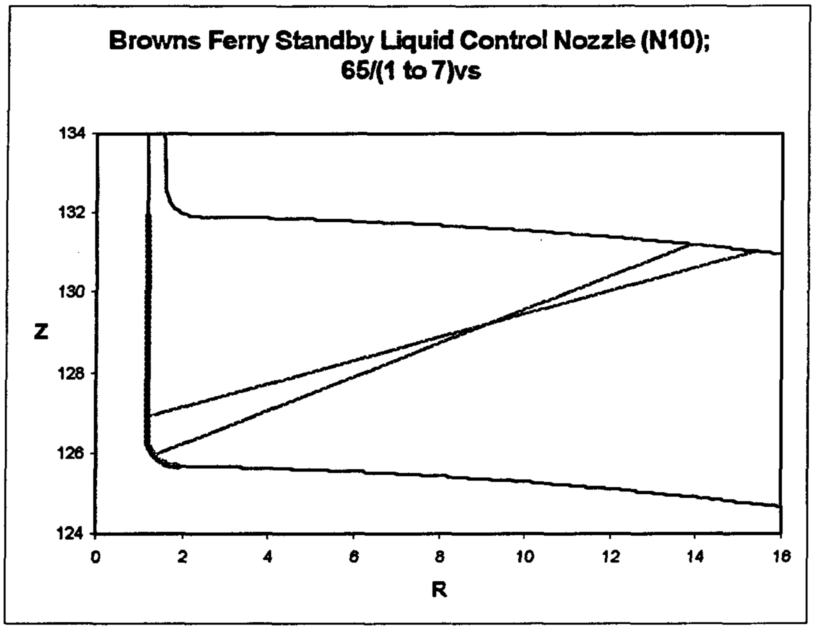


Figure 11. Browns Ferry Standby Liquid Control Nozzle (N10): Probe Scan Limits and Examination Coverage for Vessel Shell Sizing Technique, 65/(1 to 7)v.

Figure 12 shows the minimum and maximum probe radial positions and the portion of the examination volume covered by the vessel shell sizing technique, 45/(6 to 20)v, for probes scanned at the azimuth angle of 0°.

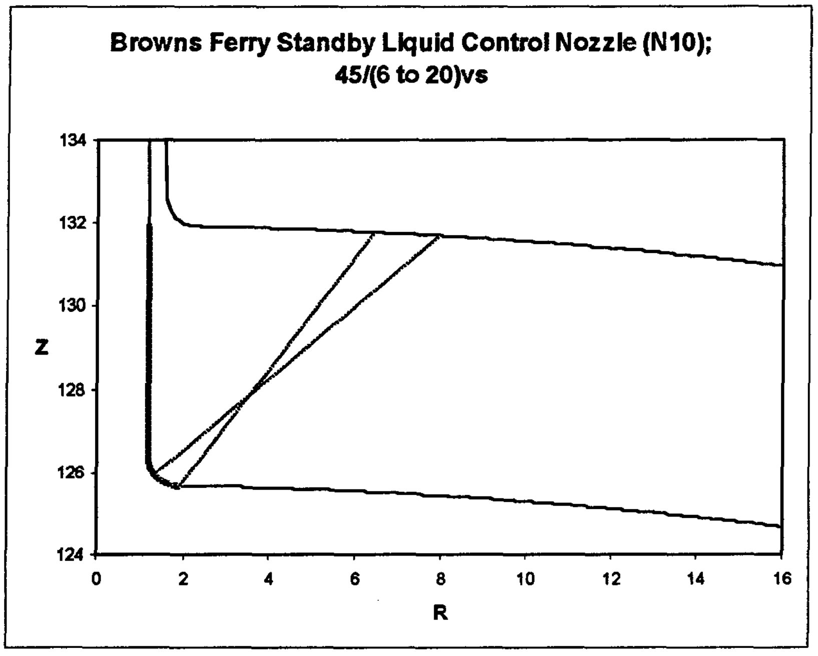


Figure 12. Browns Ferry Standby Liquid Control Nozzle (N10): Probe Scan Limits and Examination Coverage for Vessel Shell Sizing Technique, 45/(6 to 20)v.

In viewing Figures 10 through 12, each of these probe/skew angle combinations is effective within some subset of the examination volume and ineffective in other areas. The vessel shell sizing technique, 70/(2 to 21)v is effective for flaws on most of the bore, the vessel technique, 65/(1 to 7)v is effective for flaws and the lower part of the bore and the upper part of inner blend radius, and the vessel technique, 45/(6 to 20)v is effective for flaws on the remainder of the inner blend radius. Figure 13 shows the combined coverage (misorientation angle) for nozzle inner radius examination volume for the vessel shell sizing techniques; 70/(2 to 21)v, 65/(1 to 7)v, and 45/(6 to 20)v.

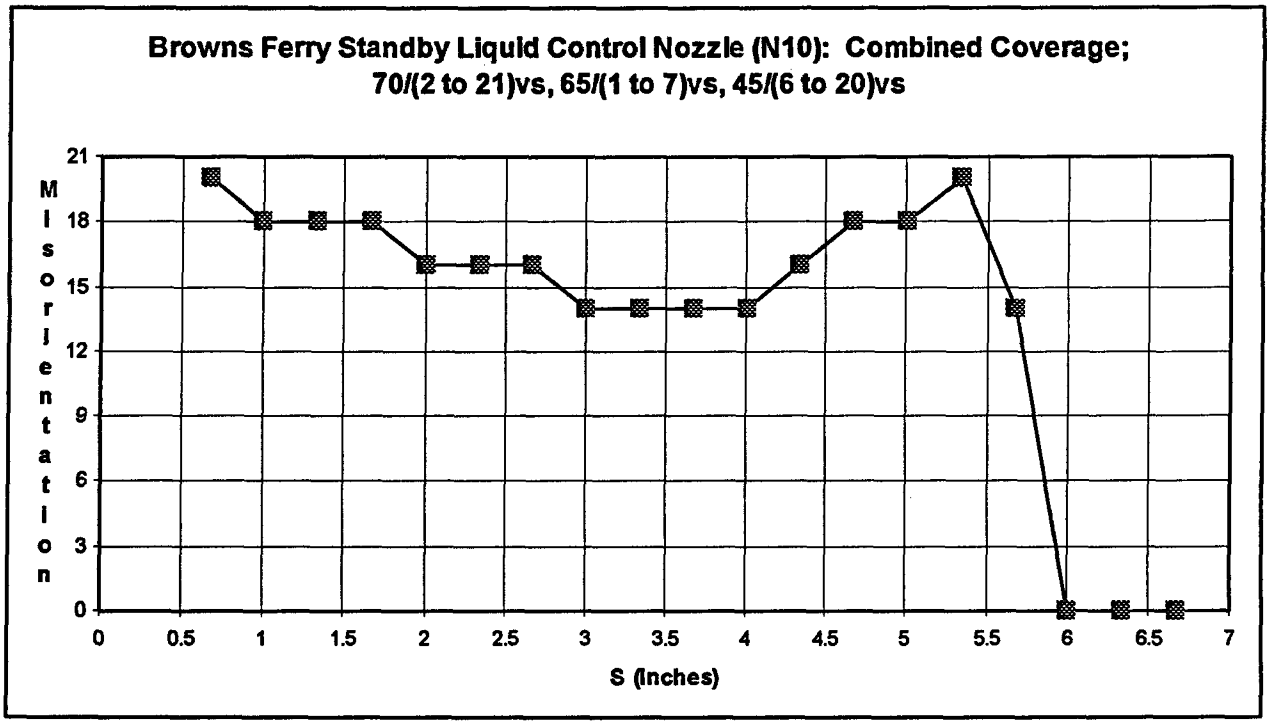


Figure 13. Browns Ferry Standby Liquid Control Nozzle (N10): Coverage Plot; Vessel Shell Sizing Techniques, 70/(2 to 21)v, 65/(1 to 7)v, and 45/(6 to 20)v.

Figure 14 shows the plot of the metal path to the points on the examination volume for the coverage shown in Figure 13.

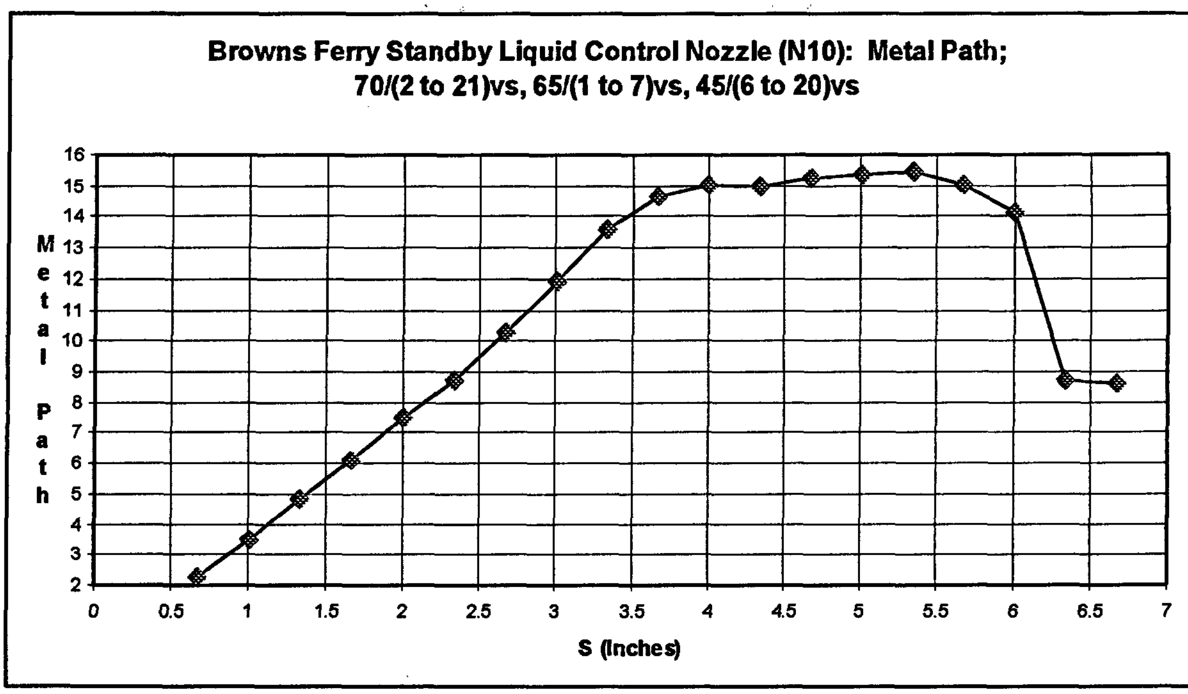


Figure 14. Browns Ferry Standby Liquid Control Nozzle (N10): Metal Path Plot; Union of Vessel Shell Sizing Techniques, 70/(2 to 21)v, 65/(1 to 7)v, and 45/(6 to 20)v.

Figure 15 shows the plot of the beam angle at the flaw (nominal inspection angle) for the points on the examination volume for the coverage shown in Figure 13.

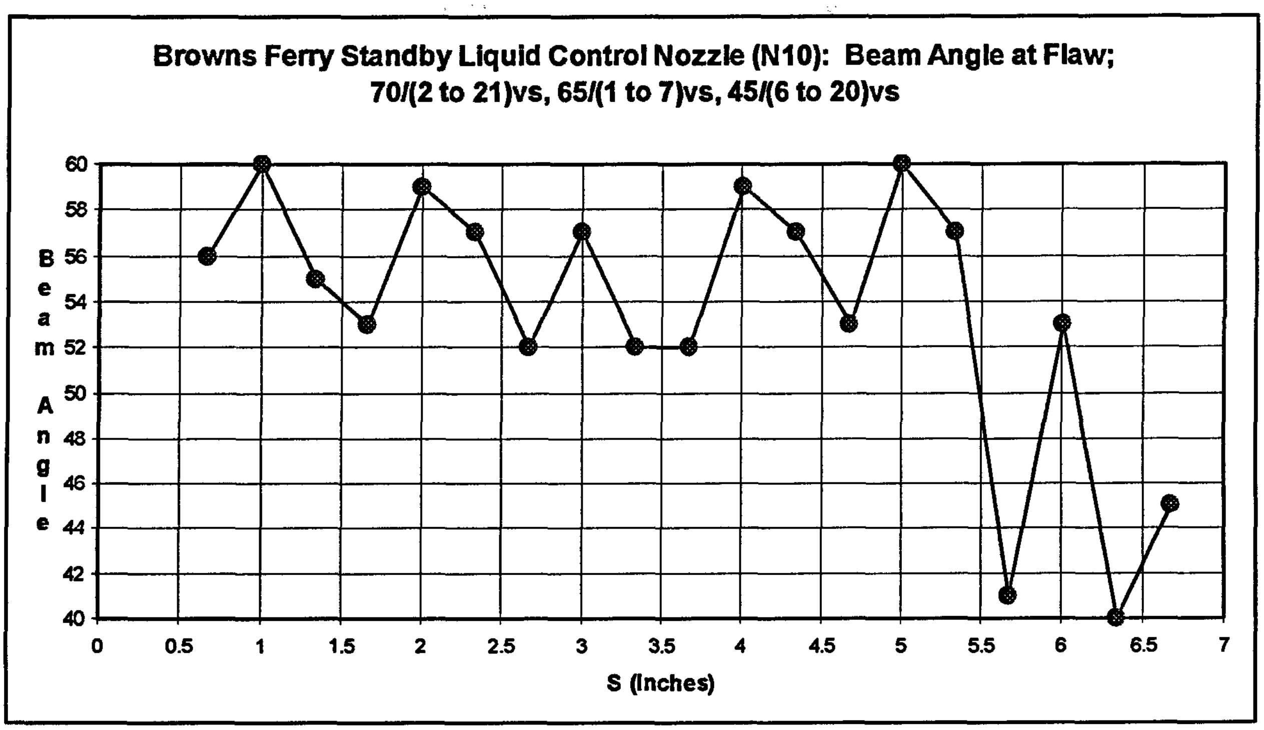


Figure 15. Browns Ferry Standby Liquid Control Nozzle: Beam Angle at Flaw; Union of Vessel Shell Sizing Techniques, 70/(2 to 21)v, 65/(1 to 7)v, and 45/(6 to 20)v.

Summary of Browns Ferry Standby Liquid Control Nozzle Inner Radius Modeling Parameters

Table 6 lists the summary of the modeling parameters for the Browns Ferry standby liquid control nozzle inner radius detection examination.

Table 6. Browns Ferry Standby Liquid Control (SLC) Nozzle (N10) Inner Corner Region Detection Examination Modeling Parameters.

Nozzle ID	Metal Path		Beam Angle at Flaw		Maximum Misorientation Angle	Percent Coverage
	Minimum	Maximum	Minimum	Maximum		
SLC (N10)	2.30	16.07	40	90	18	90

Table 7 lists the summary of the modeling parameters for the Browns Ferry standby liquid control nozzle inner radius sizing examination.

Table 7. Browns Ferry Standby Liquid Control (SLC) Nozzle (N10) Inner Corner Region Sizing Examination Modeling Parameters.

Nozzle ID	Metal Path		Beam Angle at Flaw		Maximum Misorientation Angle	Percent Coverage
	Minimum	Maximum	Minimum	Maximum		
SLC (N10)	2.25	15.45	40	60	20	90

References

1. *Ultrasonic Examination of Nozzle Inner Radius Regions.* Charlotte, North Carolina: EPRI NDE Center, December 1997. TR-107493

2. Cylinder-Sphere Tapered NIR Model Class 1 V1.0B0.xls (4/18/2003 8:03 AM)