Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

May 24, 2012

10 CFR 50.4
10 CFR 50.55a

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Unit 2
Facility Operating License No. DPR-52
NRC Docket No. 50-260

Subject: **American Society of Mechanical Engineers, Section XI Code, Inservice Inspection Program for the Unit 2 Third Ten-Year Inspection Interval, Request for Relief 2-ISI-28**

Reference: Letter from the Tennessee Valley Authority to the Nuclear Regulatory Commission, "American Society of Mechanical Engineers Section XI, Inservice Inspection, System Pressure Test, Containment Inspection, and Repair and Replacement Programs – Owner's Activity Report for Cycle 16 Operation," dated July 6, 2011

In accordance with 10 CFR 50.55a(g)(5)(iii), the Tennessee Valley Authority (TVA) is requesting relief from weld examination coverage requirements specified in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1995 Edition, 1996 Addenda as amended by 10 CFR 50.55a(b)(2)(xv)(A)(2), for one full penetration weld due to access limitations caused by design. This relief is requested for the Browns Ferry Nuclear Plant (BFN) Unit 2 Third Ten-Year Inspection Interval which began May 25, 2001 and ended May 24, 2011.

Specifically, this request for relief addresses one reactor pressure vessel nozzle-to-vessel (head) full penetration weld and nozzle inside radius section. Ultrasonic examinations were performed on the accessible areas of this weld to the maximum extent practical given the design configuration of the weld. The enclosure to this letter contains the BFN Unit 2, Request for Relief 2-ISI-28, for NRC review and approval.

A047
NRR

This request for relief is consistent with the BFN Unit 2 Request for Relief 2-ISI-6 and 2-ISI-13 submitted by TVA letter dated May 24, 2002. The NRC approved this request by letter dated April 3, 2003.

TVA requests approval of this request for relief within one year from the date of this letter.

There are no new regulatory commitments contained in this letter. If you have any questions, please contact Tom Hess at (423) 751-3487.

Respectfully,

J. W. Shea
Manager, Corporate Nuclear Licensing

Enclosure: Browns Ferry Nuclear Plant, Unit 2, American Society of Mechanical Engineers, Section XI Code Inservice Inspection Program, Third Ten-Year Inspection Interval, Request for Relief 2-ISI-28

cc (Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

Enclosure

Tennessee Valley Authority
Browns Ferry Nuclear Plant
Unit 2

American Society of Mechanical Engineers,
Section XI Code Inservice Inspection Program,
Third Ten-Year Inspection Interval

Request for Relief 2-ISI-28

(See Attached)

Enclosure

Tennessee Valley Authority
Browns Ferry Nuclear Plant
Unit 2

American Society of Mechanical Engineers,
Section XI Code Inservice Inspection Program,
Third Ten-Year Inspection Interval

Request for Relief 2-ISI-28

Executive Summary:

In accordance with 10 CFR 50.55a(g)(5)(iii), the Tennessee Valley Authority (TVA) is requesting relief from weld examination coverage requirements specified in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI for the N10 Reactor Pressure Vessel (RPV) nozzle-to-vessel full penetration weld and inside radius section ultrasonic (UT) examination performed during the Unit 2 Cycle 16 Refueling Outage in the Third period of the Third Ten-year interval.

The design configuration of the N10 RPV nozzle-to-vessel weld precludes a 100 percent UT examination of the required volume for the full penetration weld of the nozzle listed in the Table of this enclosure. This examination limitation occurs when the ASME Section XI, 2001 Edition, in accordance with 10 CFR 50.55a(b)(2)(xxiv) and, as amended by Sections 10 CFR 50.55a(b)(2)(xv)(B) through 10 CFR 50.55a(b)(2)(xv)(G), and 10 CFR 50.55a(b)(2)(xvi)(A), 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 ASME 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 the accessible areas to the maximum extent practical given the physical limitations of the subject weld. The subject weld was examined with the latest ultrasonic techniques, procedures, equipment, and personnel qualified to the requirements of the Performance Demonstration Initiative (PDI) Program, as required by 10 CFR 50.55a(g)(4), and 10 CFR 50.55a(g)(6)(ii)(C).

TVA concludes that performance of a UT examination of essentially 100 percent of the RPV nozzle-to-vessel full penetration weld and inside radius would be impractical. The performance of the UT examination of the subject weld and inside radius 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 weld and nozzle. Therefore, pursuant to 10 CFR 50.55a(g)(5)(iii), TVA requests that relief be granted for the BFN Unit 2 third Ten-Year inspection interval.

This relief is requested for the Browns Ferry Nuclear Plant (BFN) Unit 2 Third Ten-Year Inspection Interval which began May 25, 2001 and ended May 24, 2011.

Unit: Browns Ferry Nuclear Plant, Unit 2

System: Reactor Pressure Vessel (RPV), System 329

ASME Code Components Affected: One (1) RPV Nozzle-to-vessel full penetration weld and inside radius as listed in the Table of this enclosure.

ASME Code Class: ASME Code Class 1 (Equivalent)

Section XI Edition: 1995 Edition, 1996 Addenda in accordance with 10 CFR 50.55a(b)(2)(xxiv) and, as amended by Sections 10 CFR 50.55a(b)(2)(xv)(B) through 10 CFR 50.55a(b)(2)(xv)(G), and 10 CFR 50.55a(b)(2)(xvi)(A), by following the Electric Power Research Institute's (EPRI) Performance Demonstration Initiative (PDI) processes.

Code Table: IWB-2500-1

Code Examination Category: B-D, "Full Penetration Welds of Nozzles in Vessels"

Code Examination Item Number: B3.90, "Reactor Vessel Nozzle-to-Vessel Welds" and B3.100, "Nozzle Inside Radius Section"

Code Requirement: ASME Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.90 and B3.100 requires a volumetric examination of essentially 100 percent of the weld and adjacent base material and inside radius 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 and B3.100 to perform essentially 100 percent volumetric examination of the weld and adjacent base material.

List of Components Associated with this Request for Relief: Nozzle-to-Vessel Weld N10-NV and N10-IR nozzle inside radius section.

Reason for Request: The approximately 2-inch Standby Liquid Control (SLC) nozzle is designed with an integral socket to which the boron injection piping is welded. The Standby Liquid Control nozzle is located in the bottom head of the reactor pressure vessel in an area that is inaccessible for examination from inside of the vessel. The design configuration of the RPV nozzle-to-vessel (N10-NV) weld area precludes a UT examination of essentially 100 percent of the required volume. The component design configuration limits UT examination coverage of the weld to the percentages listed in the Table of this enclosure.

Proposed Alternative and Basis for Use: In lieu of the ASME Code required essentially 100 percent volume UT examination, on the nozzle to vessel weld and inside radius section, TVA proposes a UT examination of accessible areas to the maximum extent practical given the component design configuration of the RPV nozzle-to-vessel weld.

Justification for Granting Relief: The design configuration of the subject nozzle-to-vessel weld (N10-NV), precludes UT examination of essentially 100 percent of the required examination volume. The inside radius section socket is welded to piping which injects boron. In order to examine the weld in accordance with the ASME Code requirements the RPV would require extensive design modifications. The physical arrangement 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. The subject weld was examined with the latest ultrasonic techniques, procedures, equipment, and personnel qualified to the requirements of the Performance Demonstration Initiative (PDI) Program, in accordance with the requirements of the 2001 Edition, in accordance with 10 CFR 50.55a(b)(2)(xxiv) and, as amended by Sections 10 CFR 50.55a(b)(2)(xv)(B) through 10 CFR 50.55a(b)(2)(xv)(G), and 10 CFR 50.55a(b)(2)(xvi)(A), by following the Electric Power Research Institute's (EPRI) PDI processes.

Radiographic examination as an alternate volumetric examination method was determined to be impractical due to the radiological concerns and accessibility to the inside surface of the RPV to place radiographic film. The additional ASME Code coverage gained by radiography is impractical when weighed against the radiological concerns.

Therefore, TVA concludes that performing a UT examination of essentially 100 percent of the nozzle-to-vessel full penetration weld and inside radius section 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 and a visual (VT-2) examination of the nozzle area performed each refueling outage in conjunction with the Class 1 System Leakage Test provides an acceptable level of quality and safety. TVA concludes that significant degradation, if present, would be detected during a UT examination performed to the maximum extent practical of the subject weld. The inside radius section socket is welded to piping which injects boron at locations removed from the nozzle thus eliminating any thermal stratification possibility at the nozzle inside radius section. A VT-2 examination of the nozzle area, performed at each refueling outage in conjunction with the Class 1 System Leakage Test will provide for detection of flaws when they are small and can be repaired prior to the SLC nozzle losing the ability to perform its intended function. As a result, reasonable assurance of operational readiness of the subject weld and inside radius section is provided.

Therefore, pursuant to 10 CFR 50.55a(g)(5)(iii), TVA requests that relief be granted for the BFN Unit 2 third Ten-Year ISI inspection interval.

Implementation Schedule:

This request for relief is applicable to the third Ten-Year ISI inspection interval for BFN Unit 2 which began May 25, 2001 and ended May 24, 2011. The weld and inside radius section described above is listed in the Table of this enclosure. The weld and inside radius section was examined during the third period (Cycle 16 - Spring 2011) of the third Ten-Year inspection interval.

Precedent:

This request for relief is consistent with BFN Unit 2 Request for Relief 2-ISI-6 and 2-ISI-13 submitted by TVA letters dated May 24, 2002 and February 14, 2003. The NRC approved these requests by letter dated April 3, 2003.

Attachments:

Sketch (Attachment A):

SK-B2202

Examination Reports (Attachment B):

Examination Report 2-TVA-N10-NS
Examination Report 2-TVA-N10-IR

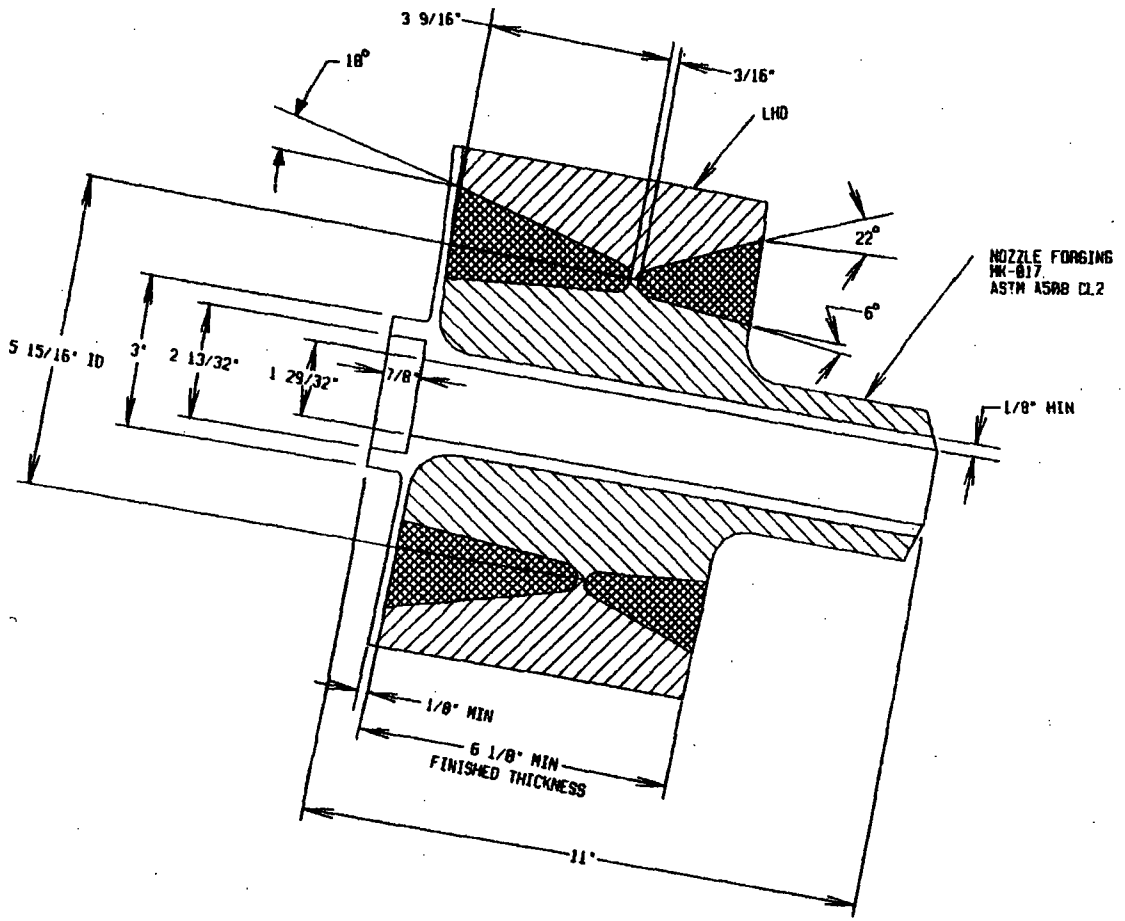
Table

Weld Number / (System)	Nominal Pipe Size (NPS)	ISI Drawing Number	Examination Coverage Percent	Unit / Cycle Inspection Performed	Comments
N10-NV / Standby Liquid Control (SLC)	~2"	SK-B2022	86.2%	2/16 (Spring 2011)	Nozzle to vessel weld (SLC Nozzle) examined using a 50 degree shear wave mode and a 60 degree longitudinal wave mode. The examination was conducted from the vessel outside diameter surface. Scanning was restricted due to nozzle configuration. This weld was examined using PDI qualified personnel, procedures, and equipment. The coverage claimed is 86.2%.
N10-IR / (SLC)	~2"	SK-B2022	90%	2/16 (Spring 2011)	Nozzle to vessel weld (SLC Nozzle Inside Radius) examined using a 65 and 70 degree shear wave mode. The examination was conducted from the vessel outside diameter surface. Scanning was restricted due to nozzle configuration. This weld was examined using PDI qualified personnel, procedures, and equipment. The coverage claimed is 90%.

Attachment A

Inservice Inspection Drawing /Sketch

Sketch SK - B2022



REFERENCE B&W DRAWING NO. 122858E-B (DETAIL B)
AND NO. 151863E-0

SKETCH RELEASE RECORD

REV	DATE	PREPARED	REVIEWED	INIT	APPROVED	INIT
0	9-15-92	M MCLAVERTY	K. TROTTER		R. HOOPER	

PURPOSE

NOTE: THIS SKETCH IS FOR ISI PROGRAM USE ONLY AND SHALL NOT BE USED FOR FABRICATION/INSTALLATION.

GE DRF NO.	PROJECT	TITLE	SKETCH NO
A00-5306	BROWNS FERRY 2	WELD DETAIL DIFFERENTIAL PRESSURE AND LIQUID CONTROL NOZZLE N18	SK-B2022

Attachment B

Weld Examination Reports

Examination Report 2-TVA-N10-NS
Examination Report 2-TVA-N10-IR

AREVA

TVA

BROWNS FERRY NUCLEAR U2R16
REACTOR VESSEL NOZZLE AND CLOSURE HEAD ULTRASONIC EXAMINATIONS
– FINAL REPORT –

SECTION 10

N10 NOZZLE-TO-VESSEL WELD EXAMINATION DATA

This section contains RV N10 Nozzle-To-Vessel Weld UT examination data.

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AREVA	Ultrasonic Examination Summary Nozzle to Vessel Welds	Report No.:	2-TVA-N10-NS
		Component ID:	N10-NV
		Work Document:	2-SI-4.6G

Customer:	TVA	Code Category:	B-D	System:	RPV (N10)
Site / Unit:	BFN 2	Code Item:	B3.90	Material:	CS (Clad)
Outage:	U2R16	Code Class:	1	ISO / Drawing(s):	122858 E / SK-B2022
Description:	Nozzle to Shell weld			EPRI Model No.:	IR-2003-31
Procedure:	N-UT-78, Rev 0005 (with PDI-UT-6, Rev G).				
Title:	PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Welds PDI-UT-6.				
Procedure:	54-ISI-850, Rev 007.				
Title:	Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (inner 15%).				

Calibration Sheets		Exam Data Sheets	Coverage Work Sheets	Coverage Diagrams	Indication Data Sheets	Indication Plot Sheets
CS-01		EDS-01	*See Comments	CDS-01	N/A	N/A
CS-02				CDS-02		
CS-03						

Exam Results:	No Recordable Indications	Exam Volume Coverage Obtained:	86.2%

Examiner: Edward P. Mazyck

In accordance with UT Procedure N-UT-78, Rev 0005, with PDI-UT-6, Rev G, and EPRI Model No. IR-2003-31, a 60° axial and circumferential examination was performed from the vessel surface. The radial exam volume includes 100% of the component thickness and the 60° circumferential examination covers the outer 85% of the component thickness.

In accordance with UT Procedure 54-ISI-850-007 and EPRI Model No. IR-2003-31, a 50° Shear wave circumferential exam was performed from the vessel surface. This examination covers the inner 15% of the examination volume.

N10 Axial Scan Modeling Parameters					
Probe Angle / Mode	Probe Skew	Min R	Max R	Min MP	Max MP
60°Long.	0	2.84	15.38	0.14	12.03

N10 Circumferential Scan Modeling Parameters					
Probe Angle / Mode	Probe Skew	Min R	Max R	Min MP	Max MP
50° Shear	±(13 to 40)	7.05	8.91	8.20	9.60
60° Long.	±(12 to 90)	2.83	10.26	0.14	10.32

This ultrasonic examination was performed in accordance with the criteria of 10CFR 50.55a (b) (2) (xv) (G) and the minimum coverage requirements of 10CFR 50.55a (b) (2) (xv) (K) was achieved to the maximum extent possible.

This examination was performed using the alternative examination volume defined in Code Case N-613-1 which reduces the area to be examined per IWB-2500-7 (a) and (b) to the weld plus a ½" on each side.

This examination satisfies the requirements of ASME Sec. XI 2001 Edition with 2003 Addenda for Appendix VIII, Category B-D, for item number B3.90, figure number IWB 2500-7(a) exam volume, and was performed using ASME Sec XI, Appendix VIII qualified personnel, procedures, and equipment as amended by the Final Rule.

Exam Coverage = 74.6% Circumferential coverage + 97.9% Axial coverage = 86.2% Total Coverage.

Personnel	Name	Signature	Level	Date
Prepared By:	Edward P. Mazyck	Edward P. Mazyck	II	03-10-2011
AREVA Review:	Paul S. Anderson		III	03-13-2011
Customer:	MATT WELCH		III	3/15/11
ANII:	Samuel Floyd			3/21/11

VE-11-019

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RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

AREVA

Component ID: N10-NV	Cal. Sheet No.: CS-01	Report No.: 2-TVA-N10 NS

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: 54-ISI-850	Rev.: 007

Procedure Title: Manual Ultrasonic Examination BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (Inner 15%)

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: KBA	Block Serial No.: BF-18
Model: USN 58Lsw	Model: 892-600	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 01TPCH	Block Thickness: ("): 6.125
Range: 12.0"	Nominal Angle (°): 50	Cal. Reflector Type: ID Notch
Velocity (in/uSec): 0.1230	Measured Angle (°): 50	Cal. Reflector Size: ("): 0.250
Delay (uSec): 28.1028	Frequency (MHz): 2.25	Cal. Reflector Depth: ("): 0.253
Frequency (MHz): 2.25	Mode: Shear	**Miscellaneous Information**
Dual: ☐ On ☒ Off	No. of Elements: 1	Cable Type: RG-174
Rectify: Fullwave	Element Size: 0.5" X 1.0"	Cable Length ('): 12
Pulse Width (ns): 220	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: N/A	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: Single	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): N/A	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 9.42 ☒MP ☐Depth	Gain (dB): 45.0	Amp (%): 80		Initial Cal.: 0920 / 03-10-2011
Verification Responses				Final Cal.: 1505 / 03-10-2011
Block No.: 6564	Reflector(s): 2" & 5"			Cal. Verification: 1218 / 03-10-2011
Response ("): 2 ☒MP ☐Depth	Gain (dB): 20.8	Amp (%): 80		Cal. Verification: N/A
Response ("): 5 ☒MP ☐Depth	Gain (dB): 20.8	Amp (%): 28		Cal. Verification: N/A

Comments:

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Paul S Anderson Level: III Date: 03-13-2011

Sign:

VE-11-019 8/23/14

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AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-NV	Cal. Sheet No.: CS-02	Report No.: 2-TVA-N10 NS

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: N-UT-78	Rev.: 0005

Procedure Title: PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Vessel Welds PDI-UT-6

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: RTD	Block Serial No.: BF-18
Model: USN 58Lsw	Model: TRL2-Aust	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 06-755	Block Thickness: (''): 6.125
Range: 6.0"	Nominal Angle (°): 60	Cal. Reflector Type: ¼ T-SDH
Velocity (in/uSec): 0.2300	Measured Angle (°): 61	Cal. Reflector Size: (''): 5/16 SDH
Delay (uSec): 15.6234	Frequency (MHz): 2.0	Cal. Reflector Depth: (''): 1.5
Frequency (MHz): 2 - 25	Mode: Longitudinal	**Miscellaneous Information**
Dual: ☒ On ☐ Off	No. of Elements: 2	Cable Type: RG-174
Rectify: Fullwave	Element Size: 2(24 X 42)mm ¼ λ	Cable Length ('): 12
Pulse Width (ns): 250	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: FD ~ 2.70"	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: D-SBS	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): 3°	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response (''): 3.152	☒MP ☐Depth	Gain (dB): 47.8	Amp (%): 80	Initial Cal.: 0910 / 03-10-2011
Verification Responses				Final Cal.: 1455 / 03-10-2011
Block No.: 6564	Reflector(s): 2" Radius			Cal. Verification: 1004 / 03-10-2011
Response (''): 2.1	☒MP ☐Depth	Gain (dB): 33.0	Amp (%): 80	Cal. Verification: N/A
Response (''): N/A	☐MP ☐Depth	Gain (dB): N/A	Amp (%): N/A	Cal. Verification: N/A

Comments:
Zone 1

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Paul S Anderson **Level:** III **Date:** 03-13-2011

Sign:

VE-11-019 2nd 5/13/11

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RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-NV	Cal. Sheet No.: CS-03	Report No.: 2-TVA-N10 NS

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: N-UT-78	Rev.: 0005

Procedure Title: PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Vessel Welds PDI-UT-6

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: RTD	Block Serial No.: BF-18
Model: USN 58Lsw	Model: TRL2-Aust	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 06-755	Block Thickness: ("): 6.125
Range: 18.0"	Nominal Angle (°): 60	Cal. Reflector Type: ID Notch
Velocity (in/uSec): 0.2300	Measured Angle (°): 61	Cal. Reflector Size: ("): 0.250
Delay (uSec): 15.6234	Frequency (MHz): 2.0	Cal. Reflector Depth: ("): 0.253
Frequency (MHz): 2 - 25	Mode: Longitudinal	**Miscellaneous Information**
Dual: ☒ On ☐ Off	No. of Elements: 2	Cable Type: RG-174
Rectify: Fullwave	Element Size: 2(24 X 42)mm ¼ λ	Cable Length ('): 12
Pulse Width (ns): 250	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: FD ~ 2.70"	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: D-SBS	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): 3°	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 12.54	☒MP ☐Depth	Gain (dB): 58.6	Amp (%): 80	Initial Cal.: 0912 / 03-10-2011
Verification Responses				Final Cal.: 1457 / 03-10-2011
Block No.: 6564	Reflector(s): 2" Radius			Cal. Verification:1110 / 03-10-2011
Response ("): 2.1	☒MP ☐Depth	Gain (dB): 33.0	Amp (%): 80	Cal. Verification: N/A
Response ("):	☐MP ☐Depth	Gain (dB):	Amp (%):	Cal. Verification: N/A

Comments:
Zone 2

Examiner: Edward P. Mazyck	Level: II	Examiner:	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Reviewer: Paul S Anderson
Sign: Paul S Anderson Level: III Date: 03-13-2011

AREVA

UT EXAMINATION DATA SHEET

Nozzle to Shell

Report No.: 2-TVA-N10-NS

Exam Data Sheet No.: EDS-01

Customer Information		
Utility: TVA	**Plant:** Browns Ferry	**Unit:** 2

Procedure / Model Information	
Proc. No.: 54-ISI-850	**Rev.:** 007
Proc. No.: N-UT-78 / PDI-UT-6	**Rev.:** 0005 / G
Table's 1 and 2: PDI-UT-6	**Rev.:** 15
Modeling Report No.: (EPRI) IR-2003-31	

Component Information
Weld ID: N10 NV
Exam Surface: Vessel O.D.
Material: Carbon Steel (Clad)
Configuration: Nozzle to Shell
System: RPV
Surface Condition: Smooth

Examination Information

L_0 Location: Nozzle Top Dead Center		**W_0 Location:** Nozzle Boss (RNozzle)	
Exam Start Date: 03-10-2011	**Exam Start Time:** 1005	**Component Temp.:** 96°	**Thermometer Serial No.:** VH-11836
Exam End Date: 03-10-2011	**Exam End Time:** 1255	**Couplant Type:** Ultragel II	**Couplant Batch No.:** 10325 B

Search Unit	Scan Surface			Examination Skew Angles	Cal Sheet No.	Exam Sensitivity	Recordable Indications	Limitations	Notes:
	Blend Radius	Nozzle Boss	Vessel						
50° Shear			X	±(13° to 40°)	CS-01	63.0	No	CDS-02	
60° RL			X	±(12° to 90°) (0°)	CS-02	65.8	No	CDS-01 / 02	Zone-1
60° RL			X	±(12° to 90°) (0°)	CS-03	68.6	No	CDS-01 / 02	Zone-2

Notes:
Scans performed as directed by EPRI Model Report No.: IR-2003 31.
Performed both axial and circumferential weld examinations using 60°RL.

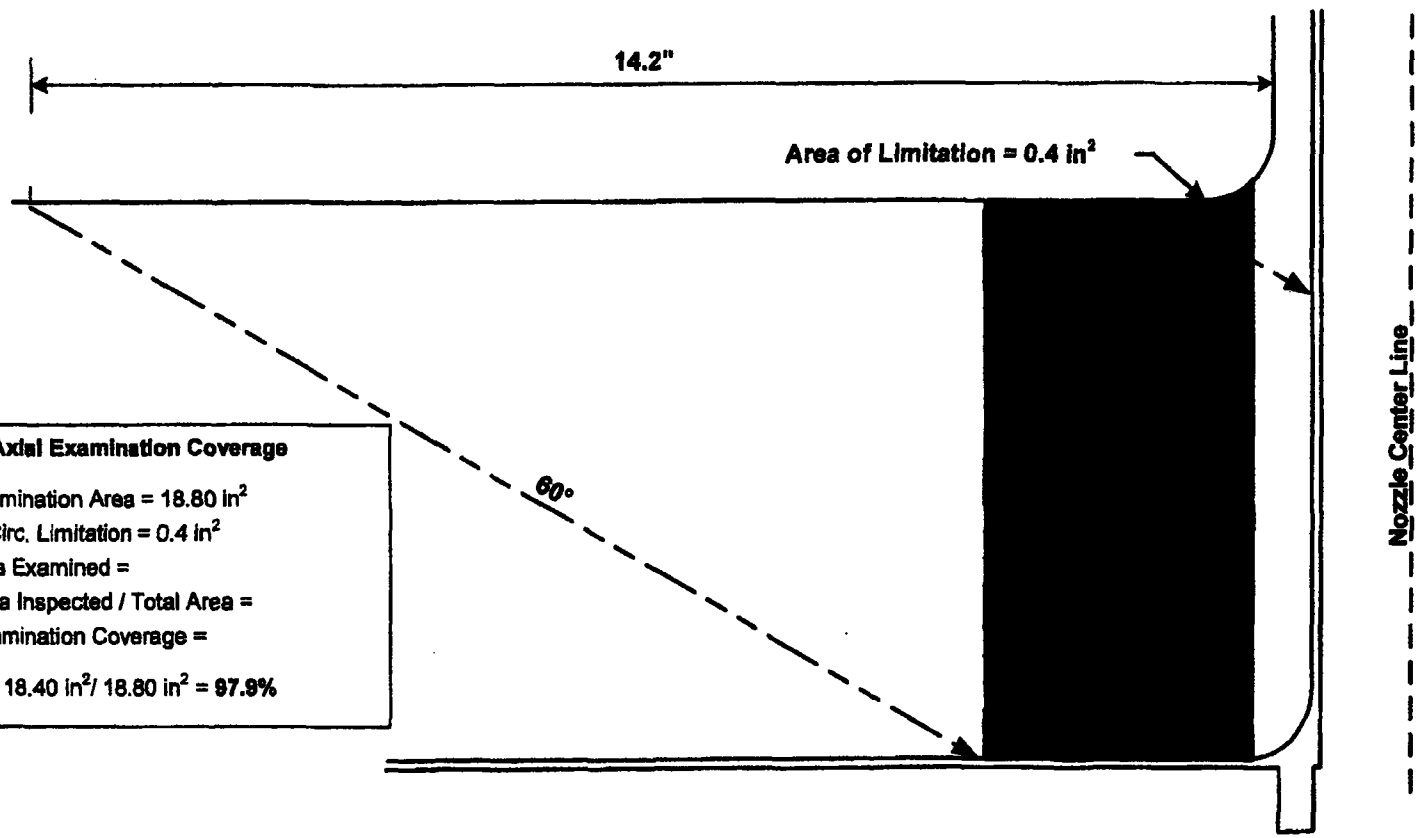
Examiner: Edward P. Mazyck **Sign:** Edward P. Mazyck	**Level:** II	**Date:** 03-10-2011	**Examiner:** N/A **Sign:**	**Level:**	**Date:**
AREVA Review: Paul S. Anderson **Sign:**	**Level:** III	**Date:** 03-13-2011			

VE-11-019
0001155 ~~0001154~~

AREVA	UT Coverage Data Sheet	Report No.: 2-TVA-N10-NS Coverage Data Sheet No.: CDS-01

Customer Information			Component Information	
Utility: TVA	Plant: Browns Ferry	Unit: 2	Weld ID: N10-NV	Configuration: Nozzle to Shell

Axial Examination Coverage



Axial Examination Coverage

Total examination Area = 18.80 in²
Area of Circ. Limitation = 0.4 in²
% of Area Examined =
Total Area Inspected / Total Area =
Total Examination Coverage =

18.40 in²/ 18.80 in² = **97.9%**

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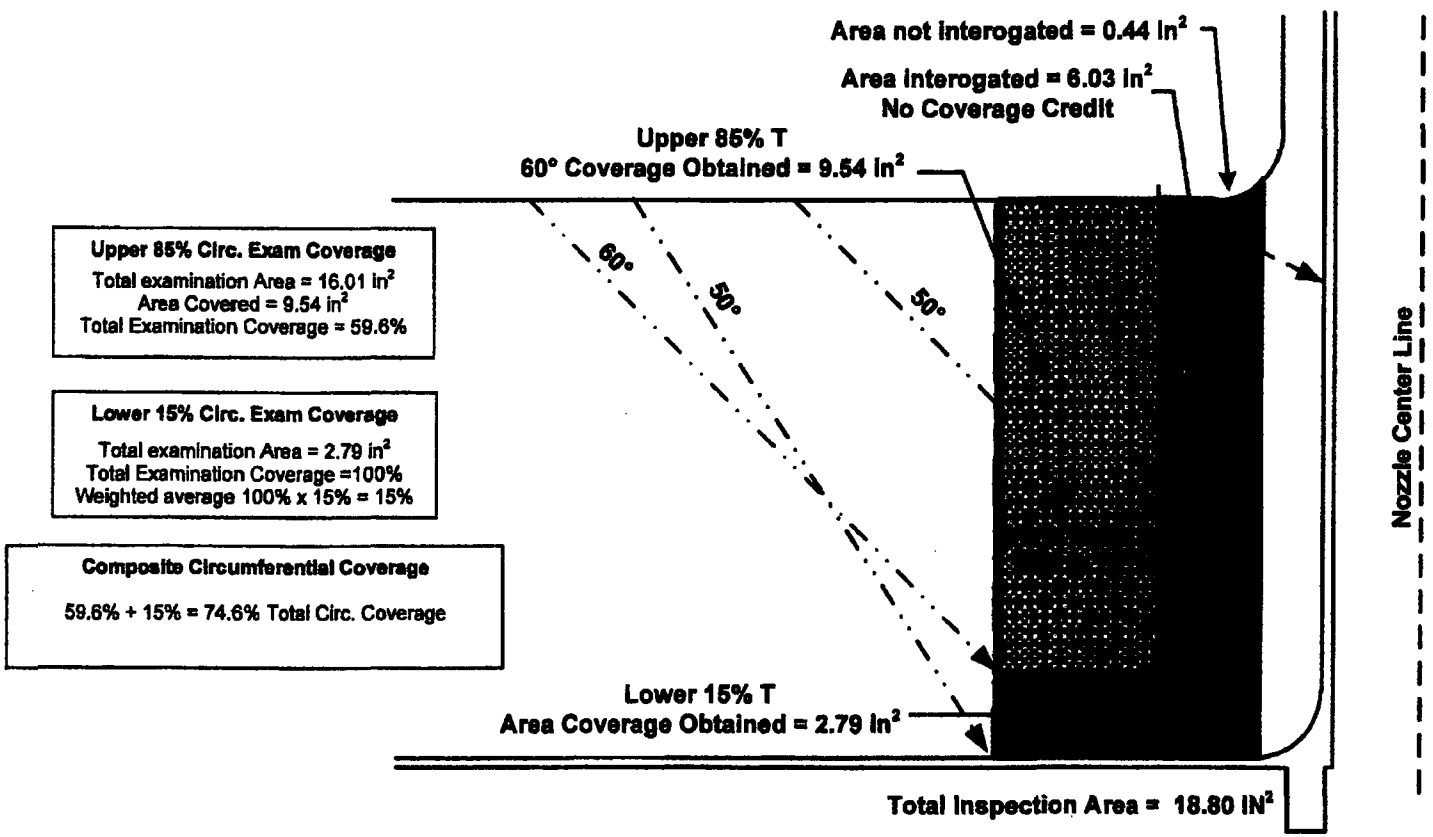
000156 000155

AREVA	UT Coverage Data Sheet	Report No.: 2-TVA-N10-NS
		Coverage Data Sheet No.: CDS-02

Customer Information			Component Information	
Utility: TVA	Plant: Browns Ferry	Unit: 2	Weld ID: N10-NV	Configuration: Nozzle to Shell

Circumferential Examination Coverage



Upper 85% Circ. Exam Coverage
Total examination Area = 16.01 in²
Area Covered = 9.54 in²
Total Examination Coverage = 59.6%

Lower 15% Circ. Exam Coverage
Total examination Area = 2.79 in²
Total Examination Coverage =100%
Weighted average 100% x 15% = 15%

Composite Circumferential Coverage
59.6% + 15% = 74.6% Total Circ. Coverage

VE-1-019 000157 ~~000136~~

000158 VE-11-019

AREVA	Ultrasonic Examination Summary Nozzle to Vessel Welds	Report No.:	2-TVA-N10-NS
		Component ID:	N10-NV
		Work Document:	2-SI-4.6G

Customer:	TVA	**Code Category:**	B-D	**System:**	RPV (N10)
Site / Unit:	BFN 2	**Code Item:**	B3.90	**Material:**	CS (Clad)
Outage:	U2R16	**Code Class:**	1	**ISO / Drawing(s):**	122858 E / SK-B2022
Description:	Nozzle to Shell weld			**EPRI Model No.:**	IR-2003-31
Procedure:	N-UT-78, Rev 0005 (with PDI-UT-6, Rev G).				
Title:	PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Welds PDI-UT-6.				
Procedure:	54-ISI-850, Rev 007.				
Title:	Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (inner 15%).				

Calibration Sheets		Exam Data Sheets	Coverage Work Sheets	Coverage Diagrams	Indication Data Sheets	Indication Plot Sheets
CS-01		EDS-01	*See Comments	CDS-01	N/A	N/A
CS-02				CDS-02		
CS-03						
Exam Results:		No Recordable Indications		**Exam Volume Coverage Obtained:**		86.2%

Examiner: Edward P. Mazyck

In accordance with UT Procedure N-UT-78, Rev 0005, with PDI-UT-6, Rev G, and EPRI Model No. IR-2003-31, a 60° axial and circumferential examination was performed from the vessel surface. The radial exam volume includes 100% of the component thickness and the 60° circumferential examination covers the outer 85% of the component thickness.

In accordance with UT Procedure 54-ISI-850-007 and EPRI Model No. IR-2003-31, a 50° Shear wave circumferential exam was performed from the vessel surface. This examination covers the inner 15% of the examination volume.

N10 Axial Scan Modeling Parameters					
Probe Angle / Mode	**Probe Skew**	**Min R**	**Max R**	**Min MP**	**Max MP**
60°Long.	0	2.84	15.38	0.14	12.03

N10 Circumferential Scan Modeling Parameters					
Probe Angle / Mode	**Probe Skew**	**Min R**	**Max R**	**Min MP**	**Max MP**
50° Shear	±(13 to 40)	7.05	8.91	8.20	9.60
60° Long.	±(12 to 90)	2.83	10.26	0.14	10.32

This ultrasonic examination was performed in accordance with the criteria of 10CFR 50.55a (b) (2) (xv) (G) and the minimum coverage requirements of 10CFR 50.55a (b) (2) (xv) (K) was achieved to the maximum extent possible.

This examination was performed using the alternative examination volume defined in Code Case N-613-1 which reduces the area to be examined per IWB-2500-7 (a) and (b) to the weld plus a ½" on each side.

This examination satisfies the requirements of ASME Sec. XI 2001 Edition with 2003 Addenda for Appendix VIII, Category B-D, for item number B3.90, figure number IWB 2500-7(a) exam volume, and was performed using ASME Sec XI, Appendix VIII qualified personnel, procedures, and equipment as amended by the Final Rule.

Exam Coverage = 74.6% Circumferential coverage + 97.9% Axial coverage = 86.2% Total Coverage.

Personnel	Name	Signature	Level	Date
Prepared By:	Edward P. Mazyck	Edward P. Mazyck	II	03-10-2011
AREVA Review:	Paul S. Anderson		III	03-13-2011
Customer:	MATT WELCH	Matt Welch	III	3/15/11
ANII:	Samuel Floyd	Samuel Floyd		3/21/11

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AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-NV	Cal. Sheet No.: CS-01	Report No.: 2-TVA-N10 NS

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: 54-ISI-850	Rev.: 007

Procedure Title: Manual Ultrasonic Examination BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (Inner 15%)

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info.
Manufacturer: Krautkramer	**Manufacturer:** KBA	**Block Serial No.:** BF-18
Model: USN 58Lsw	**Model:** 892-600	**Block Material:** CS / Clad
Serial Number: 01C3M3	**Serial No.:** 01TPCH	**Block Thickness:** (''): 6.125
Range: 12.0"	**Nominal Angle** (°): 50	**Cal. Reflector Type:** ID Notch
Velocity (in/uSec): 0.1230	**Measured Angle** (°): 50	**Cal. Reflector Size:** (''): 0.250
Delay (uSec): 28.1028	**Frequency** (MHz): 2.25	**Cal. Reflector Depth:** (''): 0.253
Frequency (MHz): 2.25	**Mode:** Shear	**Miscellaneous Information**
Dual: ☐ **On** ☒ **Off**	**No. of Elements:** 1	**Cable Type:** RG-174
Rectify: Fullwave	**Element Size:** 0.5" X 1.0"	**Cable Length** (''): 12
Pulse Width (ns): 220	**Element Shape:** Rectangle	**Intermediate Connectors:** 0
Reject (%): 0	**Focusing:** N/A	**Couplant Type:** Ultragel II
PRF / PRR Mode: AutoHigh	**Search Unit Configuration:** Single	**Couplant Batch No.:** 10325 B
Pulser / Energy: Square	**Squint Angle** (°): N/A	**Thermometer S/N:** VH-11836
Voltage (V): 450	**Wedge Radius:** N/A	**Cal. Block Temp** (° F): 76
Damping (Ω): 500	**Wedge Skew:** N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response (''): 9.42	☒**MP** ☐**Depth**	**Gain** (dB): 45.0	**Amp** (%): 80	**Initial Cal.:** 0920 / 03-10-2011
Verification Responses				**Final Cal.:** 1505 / 03-10-2011
Block No.: 6564	**Reflector(s):** 2" & 5"			**Cal. Verification:** 1218 / 03-10-2011
Response (''): 2	☒**MP** ☐**Depth**	**Gain** (dB): 20.8	**Amp** (%): 80	**Cal. Verification:** N/A
Response (''): 5	☒**MP** ☐**Depth**	**Gain** (dB): 20.8	**Amp** (%): 28	**Cal. Verification:** N/A

Comments:

Examiner: Edward P. Mazyck	**Level:** II	**Examiner:** N/A	**Level:**
Sign: Edward P. Mazyck	**Date:** 03-10-2011	**Sign:**	**Date:**

AREVA Review: Paul S Anderson **Level:** III **Date:** 03-13-2011

Sign:

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AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-NV	Cal. Sheet No.: CS-02	Report No.: 2-TVA-N10 NS

Component Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: N-UT-78	Rev.: 0005

Procedure Title: PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Vessel Welds PDI-UT-6

UT Instrumentation	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	**Manufacturer:** RTD	**Block Serial No.:** BF-18
Model: USN 58Lsw	**Model:** TRL2-Aust	**Block Material:** CS / Clad
Serial Number: 01C3M3	**Serial No.:** 06-755	**Block Thickness:** (''): 6.125
Range: 6.0"	**Nominal Angle** (°): 60	**Cal. Reflector Type:** ¼ T-SDH
Velocity (in/uSec): 0.2300	**Measured Angle** (°): 61	**Cal. Reflector Size:** (''): 5/16 SDH
Delay (uSec): 15.6234	**Frequency** (MHz): 2.0	**Cal. Reflector Depth:** (''): 1.5
Frequency (MHz): 2 - 25	**Mode:** Longitudinal	**Miscellaneous Information**
Dual: ☒ **On** ☐ **Off**	**No. of Elements:** 2	**Cable Type:** RG-174
Rectify: Fullwave	**Element Size:** 2(24 X 42)mm ¼ λ	**Cable Length** (') : 12
Pulse Width (ns): 250	**Element Shape:** Rectangle	**Intermediate Connectors:** 0
Reject (%): 0	**Focusing:** FD ~ 2.70"	**Couplant Type:** Ultragel II
PRF / PRR Mode: AutoHigh	**Search Unit Configuration:** D-SBS	**Couplant Batch No.:** 10325 B
Pulser / Energy: Square	**Squint Angle** (°): 3°	**Thermometer S/N:** VH-11836
Voltage (V): 450	**Wedge Radius:** N/A	**Cal. Block Temp** (° F): 76
Damping (Ω): 500	**Wedge Skew:** N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response (''): 3.152 ☒**MP** ☐**Depth**	**Gain** (dB): 47.8	**Amp** (%): 80		**Initial Cal.:** 0910 / 03-10-2011
Verification Responses				**Final Cal.:** 1455 / 03-10-2011
Block No.: 6564	**Reflector(s):** 2" Radius			**Cal. Verification:** 1004 / 03-10-2011
Response (''): 2.1 ☒**MP** ☐**Depth**	**Gain** (dB): 33.0	**Amp** (%): 80		**Cal. Verification:** N/A
Response (''): N/A ☐**MP** ☐**Depth**	**Gain** (dB): N/A	**Amp** (%): N/A		**Cal. Verification:** N/A

Comments:
Zone 1

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Paul S Anderson
Sign: Paul S Anderson **Level:** III **Date:** 03-13-2011

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AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-NV	Cal. Sheet No.: CS-03	Report No.: 2-TVA-N10 NS

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: N-UT-78	Rev.: 0005

Procedure Title: PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Vessel Welds PDI-UT-6

[illegible] Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	**Manufacturer:** RTD	**Block Serial No.:** BF-18
Model: USN 58Lsw	**Model:** TRL2-Aust	**Block Material:** CS / Clad
Serial Number: 01C3M3	**Serial No.:** 06-755	**Block Thickness:** ("): 6.125
Range: 18.0"	**Nominal Angle** (°): 60	**Cal. Reflector Type:** ID Notch
Velocity (in/uSec): 0.2300	**Measured Angle** (°): 61	**Cal. Reflector Size:** ("): 0.250
Delay (uSec): 15.6234	**Frequency** (MHz): 2.0	**Cal. Reflector Depth:** ("): 0.253
Frequency (MHz): 2 - 25	**Mode:** Longitudinal	**Miscellaneous Information**
Dual: ☒ **On** ☐ **Off**	**No. of Elements:** 2	**Cable Type:** RG-174
Rectify: Fullwave	**Element Size:** 2(24 X 42)mm ¼ λ	**Cable Length** ('): 12
Pulse Width (ns): 250	**Element Shape:** Rectangle	**Intermediate Connectors:** 0
Reject (%): 0	**Focusing:** FD ~ 2.70"	**Couplant Type:** Ultragel II
PRF / PRR Mode: AutoHigh	**Search Unit Configuration:** D-SBS	**Couplant Batch No.:** 10325 B
Pulser / Energy: Square	**Squint Angle** (°): 3°	**Thermometer S/N:** VH-11836
Voltage (V): 450	**Wedge Radius:** N/A	**Cal. Block Temp** (° F): 76
Damping (Ω): 500	**Wedge Skew:** N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 12.54 ☒**MP** ☐**Depth**	**Gain** (dB): 58.6	**Amp** (%): 80		**Initial Cal.:** 0912 / 03-10-2011
Verification Responses				**Final Cal.:** 1457 / 03-10-2011
Block No.: 6564	**Reflector(s):** 2" Radius			**Cal. Verification:** 1110 / 03-10-2011
Response ("): 2.1 ☒**MP** ☐**Depth**	**Gain** (dB): 33.0	**Amp** (%): 80		**Cal. Verification:** N/A
Response ("): ☐**MP** ☐**Depth**	**Gain** (dB):	**Amp** (%):		**Cal. Verification:** N/A

Comments:
Zone 2

Examiner: Edward P. Mazyck	Level: II	Examiner:	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Paul S Anderson
Sign: [signature] **Level:** III **Date:** 03-13-2011

AREVA

UT EXAMINATION DATA SHEET

Nozzle to Shell

Report No.: 2-TVA-N10-NS

Exam Data Sheet No.: EDS-01

General Information

Utility: TVA	**Plant:** Browns Ferry	**Unit:** 2	**Weld ID:** N10 NV
			Exam Surface: Vessel O.D.
Proc. No.: 54-ISI-850	**Rev.:** 007		**Material:** Carbon Steel (Clad)
Proc. No.: N-UT-78 / PDI-UT-6	**Rev.:** 0005 / G		**Configuration:** Nozzle to Shell
Table's 1 and 2: PDI-UT-6	**Rev.:** 15		**System:** RPV
Modeling Report No.: (EPRI) IR-2003-31			**Surface Condition:** Smooth

Examination Information

L_0 Location: Nozzle Top Dead Center		**W_0 Location:** Nozzle Boss (RNozzle)	
Exam Start Date: 03-10-2011	**Exam Start Time:** 1005	**Component Temp.:** 96°	**Thermometer Serial No.:** VH-11836
Exam End Date: 03-10-2011	**Exam End Time:** 1255	**Couplant Type:** Ultragel II	**Couplant Batch No.:** 10325 B

Search Unit	Scan Surface			Examination Skew Angles	Cal Sheet No.	Exam Sensitivity	Recordable Indications	Limitations	Notes:
	Blend Radius	Nozzle Boss	Vessel						
50° Shear			X	±(13° to 40°)	CS-01	63.0	No	CDS-02	
60° RL			X	±(12° to 90°) (0°)	CS-02	65.8	No	CDS-01 / 02	Zone-1
60° RL			X	±(12° to 90°) (0°)	CS-03	68.6	No	CDS-01 / 02	Zone-2

Notes:
Scans performed as directed by EPRI Model Report No.: IR-2003 31.
Performed both axial and circumferential weld examinations using 60°RL.

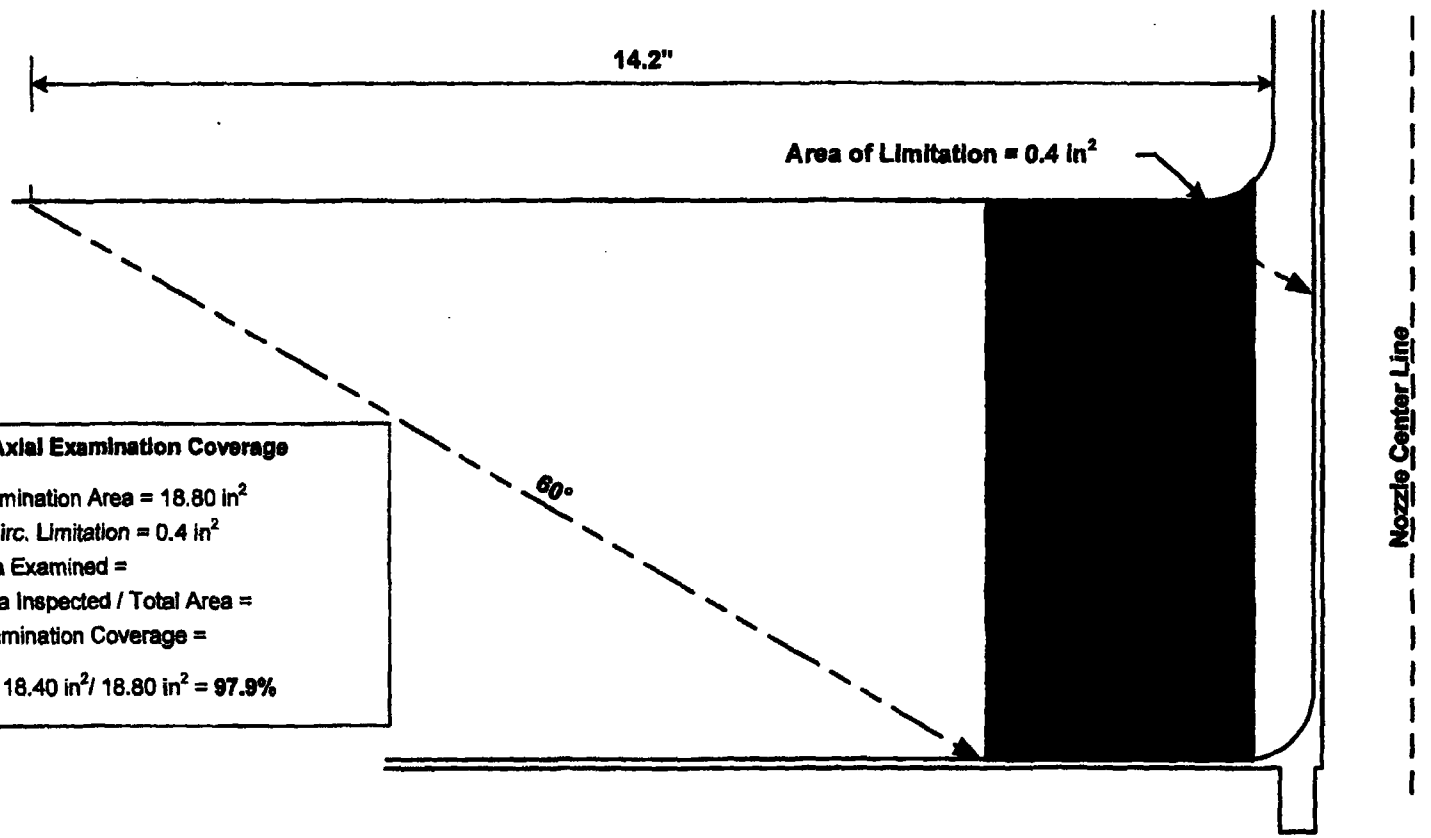
Examiner: Edward P. Mazyck **Sign:** Edward P. Mazyck	**Level:** II	**Date:** 03-10-2011	**Examiner:** N/A **Sign:**	**Level:**	**Date:**
AREVA Review: Paul S. Anderson **Sign:**	**Level:** III	**Date:** 03-13-2011			

0001162 VE-I-019

AREVA	UT Coverage Data Sheet	Report No.: 2-TVA-N10-NS Coverage Data Sheet No.: CDS-01

Customer Information			Component Information	
Utility: TVA	Plant: Browns Ferry	Unit: 2	Weld ID: N10-NV	Configuration: Nozzle to Shell

Axial Examination Coverage



Axial Examination Coverage

Total examination Area = 18.80 in²
Area of Circ. Limitation = 0.4 in²
% of Area Examined =
Total Area Inspected / Total Area =
Total Examination Coverage =

18.40 in²/ 18.80 in² = **97.9%**

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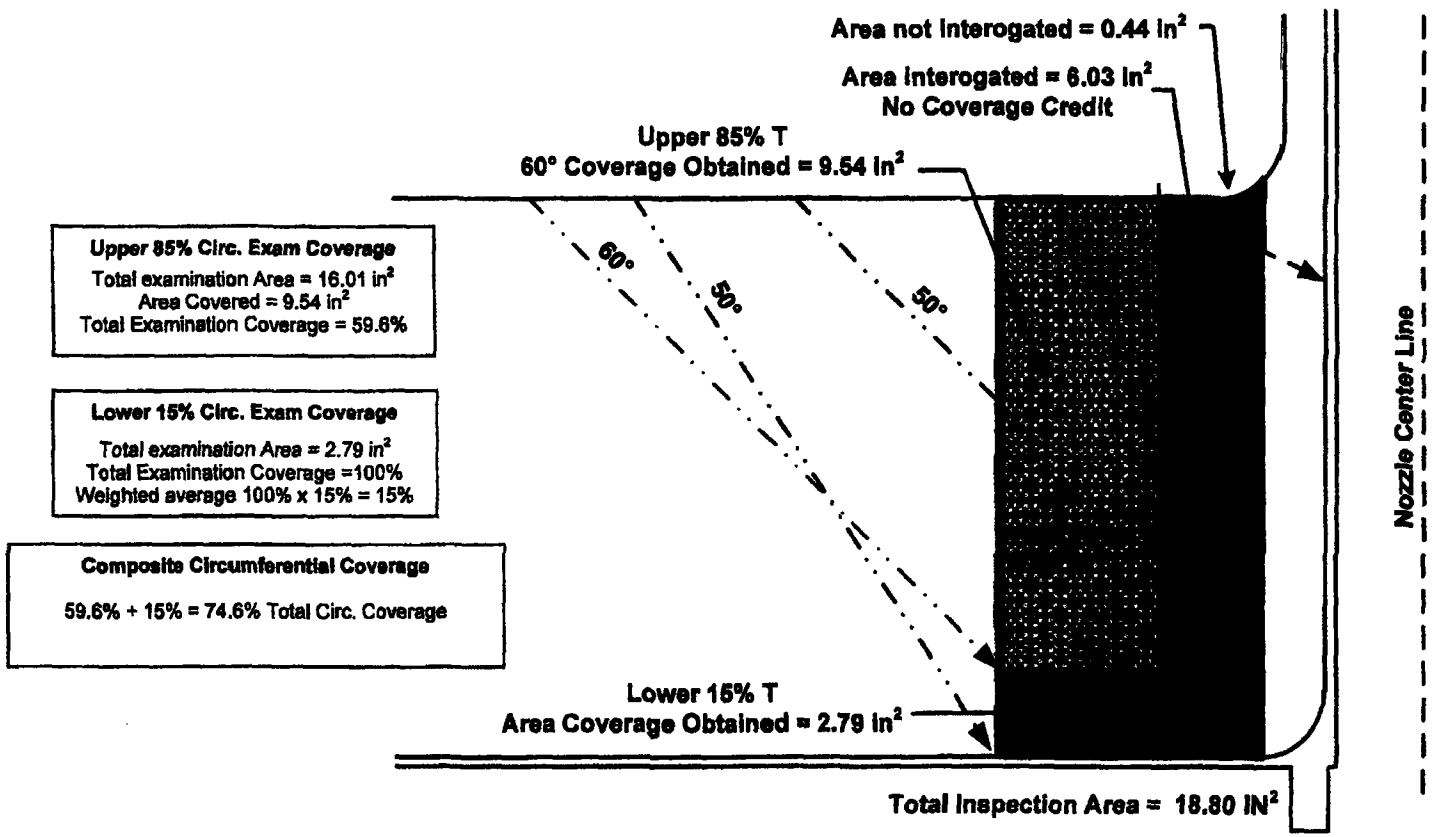
AREVA	UT Coverage Data Sheet	Report No.: 2-TVA-N10-NS
		Coverage Data Sheet No.: CDS-02

Customer Information			Component Information	
Utility: TVA	Plant: Browns Ferry	Unit: 2	Weld ID: N10-NV	Configuration: Nozzle to Shell

Circumferential Examination Coverage



Upper 85% Circ. Exam Coverage
Total examination Area = 16.01 in²
Area Covered = 9.54 in²
Total Examination Coverage = 59.6%

Lower 15% Circ. Exam Coverage
Total examination Area = 2.79 in²
Total Examination Coverage =100%
Weighted average 100% x 15% = 15%

Composite Circumferential Coverage
59.6% + 15% = 74.6% Total Circ. Coverage

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AREVA

TVA

BROWNS FERRY NUCLEAR U2R16
REACTOR VESSEL NOZZLE AND CLOSURE HEAD ULTRASONIC EXAMINATIONS
– FINAL REPORT –

SECTION 11

N10 NOZZLE INNER RADIUS REGION EXAMINATION DATA

This section contains RV N10 Inner Radius Region UT examination data.

AREVA	Ultrasonic Examination Summary Inner Radius	Report No.:	2-TVA-N10-IR
		Component ID:	N10-IR
		Work Document:	2-SI-4.6G

Customer:	TVA	Code Category:	B-D	System:	RPV (N10)
Site / Unit:	BFN 2	Code Item:	B3.100	Material:	CS (Clad)
Outage:	U2R16	Code Class:	1	ISO / Drawing(s):	122858 E / SK-B2022
Description:	Nozzle Inside Radius Section			EPRI Model No.:	IR-2004-43
Procedure:	54-ISI-850, Rev 007				
Title:	Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (inner 15%).				

Calibration Sheets	Exam Data Sheets	Coverage Work Sheets	Coverage Diagrams	Indication Data Sheets	Indication Plot Sheets
CS-01	EDS-01	See Note 1	N/A	N/A	N/A
CS-02					

Exam Results:	No Recordable Indications	Exam Volume Coverage Obtained:	90%

In accordance with UT Procedure 54-ISI-850-007 and EPRI Model No. IR-2004-43, a 65° and 70° Shear wave Inner Radius examinations were performed from the vessel O.D. surface.

N10 Circumferential Scan Modeling Parameters					
Probe Angle / Mode	Probe Skew	Min R	Max R	Min MP	Max MP
65° / Shear	±(1 to 10)	13.85"	15.54"	14.14"	16.07"
70° / Shear	±(2 to 23)	2.94"	15.54"	2.30"	16.07"

(1) Reference EPRI Report IR-2004-43 for exam volume and coverage.

This examination satisfies the requirements of ASME Sec. XI 2001 Edition with 2003 Addenda for Appendix VIII, Category B-D, for item number B3.100, figure number IWB 2500-7(a) exam volume, and was performed using ASME Sec XI, Appendix VIII qualified personnel, procedures, and equipment as amended by the Final Rule.

Personnel	Name	Signature	Level	Date
Prepared By:	Edward P. Mazyck	Edward P. Mazyck	II	03-10-2011
AREVA Review:	Paul S. Anderson		III	03-13-2011
Customer:	MATT WELCH		III	3/15/11
ANII:				3/24/11

AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-IR	Cal. Sheet No.: CS-01	Report No.: 2-TVA-N10-IR

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: 54-ISI-850	Rev.: 007

Procedure Title: Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (Inner 15%)

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: KBA	Block Serial No.: BF-18
Model: USN 58Lsw	Model: 892-600	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 01TPCJ	Block Thickness: ("): 6.125
Range: 18.0"	Nominal Angle (°): 65	Cal. Reflector Type: ID Notch
Velocity (in/uSec): 0.1230	Measured Angle (°): 65	Cal. Reflector Size: ("): 0.250
Delay (uSec): 14.7300	Frequency (MHz): 2.25	Cal. Reflector Depth: ("): 0.253
Frequency (MHz): 2.25	Mode: Shear	**Miscellaneous Information**
Dual: ☐ On ☒ Off	No. of Elements: 1	Cable Type: RG-174
Rectify: Fullwave	Element Size: 0.5" X 1.0"	Cable Length ('): 12
Pulse Width (ns): 220	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: N/A	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: Single	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): N/A	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 13.77 ☒MP ☐Depth	Gain (dB): 53.0	Amp (%): 80		Initial Cal.: 0930 / 03-10-2011
Verification Responses				Final Cal.: 1508 / 03-10-2011
Block No.: 6564	Reflector(s): 2" & 5"			Cal. Verification: 1256 / 03-10-2011
Response ("): 2" ☒MP ☐Depth	Gain (dB): 18.8	Amp (%): 80		Cal. Verification: N/A
Response ("): 5" ☒MP ☐Depth	Gain (dB): 18.8	Amp (%): 28		Cal. Verification: N/A

Comments:
Min. MP = 14.14"
Max MP = 16.07"

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Dan Langenfeld Level: III Date: 03-13-2011
Sign: Dan Langenfeld

AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-IR	Cal. Sheet No.: CS-02	Report No.: 2-TVA-N10-IR

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: 54-ISI-850	Rev.: 007

Procedure Title: Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (Inner 15%)

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: KBA	Block Serial No.: BF-18
Model: USN 58Lsw	Model: 892-600	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 01C4NX	Block Thickness: ("): 6.125
Range: 18.0"	Nominal Angle (°): 70	Cal. Reflector Type: ¾ T-SDH
Velocity (in/uSec): 0.1230	Measured Angle (°): 70	Cal. Reflector Size: ("): 5/16 DIA.
Delay (uSec): 14.0400	Frequency (MHz): 2.25	Cal. Reflector Depth: ("): 4.375
Frequency (MHz): 2.25	Mode: Shear	**Miscellaneous Information**
Dual: ☐ On ☒ Off	No. of Elements: 1	Cable Type: RG-174
Rectify: Fullwave	Element Size: 0.5" X 1.0"	Cable Length ('): 12
Pulse Width (ns): 220	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: N/A	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: Single	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): N/A	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 12.79 ☒MP ☐Depth	Gain (dB): 54.4	Amp (%): 80		Initial Cal.: 0925 / 03-10-2011
Verification Responses				Final Cal.: 1508 / 03-10-2011
Block No.: 6564	Reflector(s): 2" & 5"			Cal. Verification: 1336 / 03-10-2011
Response ("): 2" ☒MP ☐Depth	Gain (dB): 25.5	Amp (%): 80		Cal. Verification: N/A
Response ("): 5" ☒MP ☐Depth	Gain (dB): 25.5	Amp (%): 40		Cal. Verification: N/A

Comments:
Min. MP = 2.30"
Max MP = 16.07"

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Dan Langenfeld **Level:** III **Date:** 03-13-2011
Sign: Dan Langenfeld

AREVA

UT EXAMINATION DATA SHEET

Nozzle Inner Radius

Report No.: 2-TVA-N10-IR

Exam Data Sheet No.: EDS-01

Customer Information			Component Information	
Utility: TVA	**Plant:** Browns Ferry	**Unit:** 2	**Weld ID:** N10 IR	**System:** RPV
Procedure / Model Information			**Exam Surface:** Vessel O.D.	**Surface Condition:** Smooth
Proc. No.: 54-ISI-850	**Rev.:** 007		**Material:** Carbon Steel (Clad)	
Modeling Report No.: (EPRI) IR-2004-43			**Configuration:** Inner Radius	

Examination Information

L_0 Location: Nozzle Top Dead Center		**W_0 Location:** Nozzle Boss (RNozzle)	
Exam Start Date: 03-10-2011	**Exam Start Time:** 1258	**Component Temp.:** 96°	**Thermometer Serial No.:** VH-11836
Exam End Date: 03-10-2011	**Exam End Time:** 1430	**Couplant Type:** Ultragel II	**Couplant Batch No.:** 10325 B

Search Unit	Scan Surface			Examination Skew Angles	Cal Sheet No.	Exam Sensitivity	Recordable Indications	Limitations	Notes:
	Blend Radius	Nozzle Boss	Vessel						
65° Shear			X	±(1 to 10)°	CS-01	65.0	No	None	
70° Shear			X	±(2 to 23)°	CS-02	66.4	No	None	

Notes: Scans performed as directed by EPRI Model Report No.: IR-2004 43.

Summary of Detection Modeling Parameters – IR-2004-43					
Metal Path		Beam angle at flaw		Maximum Misorientation Angle	% Coverage
Min	Max	Min	Max		
2.30	16.07	40	90	18°	90

Examiner: Edward P. Mazyck **Sign:** Edward P. Mazyck	**Level:** II	**Date:** 03-10-2011	**Examiner:** N/A **Sign:**	**Level:**	**Date:**
AREVA Review: Dan Langenfeld **Sign:** Dan Langenfeld	**Level:** III	**Date:** 03-13-2011			

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AREVA	Ultrasonic Examination Summary Inner Radius	Report No.:	2-TVA-N10-IR
		Component ID:	N10-IR
		Work Document:	2-SI-4.6G

Customer:	TVA	**Code Category:**	B-D	**System:**	RPV (N10)
Site / Unit:	BFN 2	**Code Item:**	B3.100	**Material:**	CS (Clad)
Outage:	U2R16	**Code Class:**	1	**ISO / Drawing(s):**	122858 E / SK-B2022
Description:	Nozzle Inside Radius Section			**EPRI Model No.:**	IR-2004-43
Procedure:	54-ISI-850, Rev 007				
Title:	Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (inner 15%).				

Calibration Sheets	Exam Data Sheets	Coverage Work Sheets	Coverage Diagrams	Indication Data Sheets	Indication Plot Sheets
CS-01	EDS-01	See Note 1	N/A	N/A	N/A
CS-02					

Exam Results:	No Recordable Indications	**Exam Volume Coverage Obtained:**	90%

In accordance with UT Procedure 54-ISI-850-007 and EPRI Model No. IR-2004-43, a 65° and 70° Shear wave Inner Radius examinations were performed from the vessel O.D. surface.

N10 Circumferential Scan Modeling Parameters					
Probe Angle / Mode	**Probe Skew**	**Min R**	**Max R**	**Min MP**	**Max MP**
65° / Shear	±(1 to 10)	13.85"	15.54"	14.14"	16.07"
70° / Shear	±(2 to 23)	2.94"	15.54"	2.30"	16.07"

(1) Reference EPRI Report IR-2004-43 for exam volume and coverage.

This examination satisfies the requirements of ASME Sec. XI 2001 Edition with 2003 Addenda for Appendix VIII, Category B-D, for item number B3.100, figure number IWB 2500-7(a) exam volume, and was performed using ASME Sec XI, Appendix VIII qualified personnel, procedures, and equipment as amended by the Final Rule.

Personnel	Name	Signature	Level	Date
Prepared By:	Edward P. Mazyck	Edward P. Mazyck	II	03-10-2011
AREVA Review:	Paul S. Anderson		III	03-13-2011
Customer:	MATT WELCH		III	3/15/11
ANII:				3/21/11

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AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-IR	Cal. Sheet No.: CS-01	Report No.: 2-TVA-N10-IR

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: 54-ISI-850	Rev.: 007

Procedure Title: Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (Inner 15%)

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: KBA	Block Serial No.: BF-18
Model: USN 58Lsw	Model: 892-600	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 01TPCJ	Block Thickness ("): 6.125
Range: 18.0"	Nominal Angle (°): 65	Cal. Reflector Type: ID Notch
Velocity (in/uSec): 0.1230	Measured Angle (°): 65	Cal. Reflector Size ("): 0.250
Delay (uSec): 14.7300	Frequency (MHz): 2.25	Cal. Reflector Depth ("): 0.253
Frequency (MHz): 2.25	Mode: Shear	**Miscellaneous Information**
Dual: ☐ On ☒ Off	No. of Elements: 1	Cable Type: RG-174
Rectify: Fullwave	Element Size: 0.5" X 1.0"	Cable Length ('): 12
Pulse Width (ns): 220	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: N/A	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: Single	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): N/A	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 13.77 ☒MP ☐Depth	Gain (dB): 53.0	Amp (%): 80		Initial Cal.: 0930 / 03-10-2011
Verification Responses				Final Cal.: 1508 / 03-10-2011
Block No.: 6564	Reflector(s): 2" & 5"			Cal. Verification: 1256 / 03-10-2011
Response ("): 2" ☒MP ☐Depth	Gain (dB): 18.8	Amp (%): 80		Cal. Verification: N/A
Response ("): 5" ☒MP ☐Depth	Gain (dB): 18.8	Amp (%): 28		Cal. Verification: N/A

Comments:
Min. MP = 14.14"
Max MP = 16.07"

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Dan Langenfeld
Sign: Dan Langenfeld
Level: III
Date: 03-13-2011

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AREVA

RPV MANUAL ULTRASONIC CALIBRATION DATA SHEET

Component ID: N10-IR	Cal. Sheet No.: CS-02	Report No.: 2-TVA-N10-IR

Customer Information

Utility: TVA	Site: Browns Ferry	Unit: 2

Procedure Information

Procedure Number: 54-ISI-850	Rev.: 007

Procedure Title: Manual Ultrasonic Examination of BWR Reactor Vessel Nozzle Inner Radius Regions and Nozzle to Shell Welds (Inner 15%)

UT Instrument Information	Search Unit Information	Reference / Cal. Block Info
Manufacturer: Krautkramer	Manufacturer: KBA	Block Serial No.: BF-18
Model: USN 58Lsw	Model: 892-600	Block Material: CS / Clad
Serial Number: 01C3M3	Serial No.: 01C4NX	Block Thickness ("): 6.125
Range: 18.0"	Nominal Angle (°): 70	Cal. Reflector Type: ¾ T-SDH
Velocity (in/uSec): 0.1230	Measured Angle (°): 70	Cal. Reflector Size ("): 5/16 DIA.
Delay (uSec): 14.0400	Frequency (MHz): 2.25	Cal. Reflector Depth ("): 4.375
Frequency (MHz): 2.25	Mode: Shear	**Miscellaneous Information**
Dual: ☐ On ☒ Off	No. of Elements: 1	Cable Type: RG-174
Rectify: Fullwave	Element Size: 0.5" X 1.0"	Cable Length ('): 12
Pulse Width (ns): 220	Element Shape: Rectangle	Intermediate Connectors: 0
Reject (%): 0	Focusing: N/A	Couplant Type: Ultragel II
PRF / PRR Mode: AutoHigh	Search Unit Configuration: Single	Couplant Batch No.: 10325 B
Pulser / Energy: Square	Squint Angle (°): N/A	Thermometer S/N: VH-11836
Voltage (V): 450	Wedge Radius: N/A	Cal. Block Temp (° F): 76
Damping (Ω): 500	Wedge Skew: N/A	

Calibration / Verification Information

Calibration Responses				Calibration Time / Date
Response ("): 12.79	☒MP ☐Depth	Gain (dB): 54.4	Amp (%): 80	Initial Cal.: 0925 / 03-10-2011
Verification Responses				Final Cal.: 1508 / 03-10-2011
Block No.: 6564	Reflector(s): 2" & 5"			Cal. Verification: 1336 / 03-10-2011
Response ("): 2"	☒MP ☐Depth	Gain (dB): 25.5	Amp (%): 80	Cal. Verification: N/A
Response ("): 5"	☒MP ☐Depth	Gain (dB): 25.5	Amp (%): 40	Cal. Verification: N/A

Comments:
Min. MP = 2.30"
Max MP = 16.07"

Examiner: Edward P. Mazyck	Level: II	Examiner: N/A	Level:
Sign: Edward P. Mazyck	Date: 03-10-2011	Sign:	Date:

AREVA Review: Dan Langenfeld
Sign: Dan Langenfeld
Level: III
Date: 03-13-2011

AREVA

UT EXAMINATION DATA SHEET

Nozzle Inner Radius

Report No.: 2-TVA-N10-IR

Exam Data Sheet No.: EDS-01

Customer Information			Component Information	
Utility: TVA	**Plant:** Browns Ferry	**Unit:** 2	**Weld ID:** N10 IR	**System:** RPV
Procedure / Model Information			**Exam Surface:** Vessel O.D.	**Surface Condition:** Smooth
Proc. No.: 54-ISI-850	**Rev.:** 007		**Material:** Carbon Steel (Clad)	
Modeling Report No.: (EPRI) IR-2004-43			**Configuration:** Inner Radius	

Examination Information

L_0 Location: Nozzle Top Dead Center		**W_0 Location:** Nozzle Boss (RNozzle)	
Exam Start Date: 03-10-2011	**Exam Start Time:** 1258	**Component Temp.:** 96°	**Thermometer Serial No.:** VH-11836
Exam End Date: 03-10-2011	**Exam End Time:** 1430	**Couplant Type:** Ultragel II	**Couplant Batch No.:** 10325 B

Search Unit	Scan Surface			Examination Skew Angles	Cal Sheet No.	Exam Sensitivity	Recordable Indications	Limitations	Notes:
	Blend Radius	Nozzle Boss	Vessel						
65° Shear			X	±(1 to 10)°	CS-01	65.0	No	None	
70° Shear			X	±(2 to 23)°	CS-02	66.4	No	None	

Notes: Scans performed as directed by EPRI Model Report No.: IR-2004 43.

Summary of Detection Modeling Parameters – IR-2004-43					
Metal Path		Beam angle at flaw		Maximum Misorientation Angle	% Coverage
Min	Max	Min	Max		
2.30	16.07	40	90	18°	90

Examiner: Edward P. Mazyck **Sign:** Edward P. Mazyck	**Level:** II	**Date:** 03-10-2011	**Examiner:** N/A **Sign:**	**Level:**	**Date:**
AREVA Review: Dan Langenfeld **Sign:** Dan Langenfeld	**Level:** III	**Date:** 03-13-2011			

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