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SUBJECT: Forwards results of Unit 2 core shroud insp committed to in util 940823 response to GL 94-03.

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November 18, 1994

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10CFR50.54(f)

Gentlemen:
In the Matter of)
Tennessee Valley Authority)

Docket No. 50-260

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 2 - RESULTS OF CORE SHROUD INSPECTION (TAC NO. M90082)

This letter provides the results of the Unit 2 core shroud inspection committed to in TVA's August 23, 1994, response to Generic Letter (GL) 94-03, "Intergranular Stress Corrosion Cracking (IGSCC) of Shrouds in Boiling Water Reactors." The inspection was performed during the Unit 2 Cycle 7 refueling outage and completed on October 22, 1994.

The results of the inspection indicate that severe core shroud cracking is not occurring in Unit 2. Minor surface connected planar indications were found on three welds. No through wall cracks were identified. The inspection results were obtained by qualified personnel using the best available technology. TVA performed non-destructive examinations (NDE) of 100% of the accessible areas on the horizontal welds using the GE Smart-2000 system and suction cup scanners. An enhanced video system (Westinghouse 1250 camera) was used in selected areas to look for obstructions and assist in setting up ultrasonic test equipment.

TVA evaluated the Unit 2 inspection results and determined that Unit 2 can safely be returned to service and operated for at least two additional operating cycles without repairs. The analysis indicates that postulated crack growth during the next two operating cycles will be less than the safety criteria established by General Electric (GE) and the Boiling Water Reactors Owners Group (BWROG) (GE NE-523-A107P-0794 and BWROG letters to NRC dated July 13 and 14, 1994). TVA's analysis used conservative

A030
1/1

assumptions for such factors as crack growth and uncertainties in the amount of cracking identified. Summaries of the inspection results and TVA's safety analysis that supports restart and operation of the Unit 2 core shroud are provided in the enclosure.

TVA is continuing to work with the BWROG and GE to develop acceptable repair methodologies when repair becomes necessary, and develop inspection plans for conducting weld examinations on the remaining core shroud welds. TVA will keep NRC informed about future repair and inspection activities as information becomes available and plans are finalized.

There are no commitments contained in this letter. If you have any question please telephone me at (205) 729-2636.

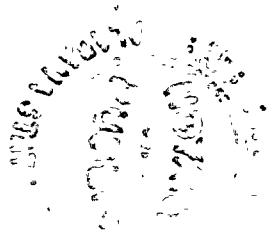
Sincerely,

Pedro Salas
Site Licensing Manager

Subscribed and sworn to before me
on this 18th day of November 1994.

Barbara A. Blanton
Notary Public
My Commission Expires My Commission Expires 10/06/98

Enclosure
cc: see page 2



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ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 2

BFN UNIT 2 REACTOR CORE SHROUD INSPECTION RESULTS AND ANALYSIS

I. BACKGROUND

Intergranular stress corrosion cracking (IGSCC) of boiling water reactor (BWR) internals has been identified as a technical issue of concern by NRC and the nuclear industry. TVA has been fully aware of IGSCC concerns in the core shroud and has been working closely with General Electric (GE) and the Boiling Water Reactor Owners Group (BWROG) to address this issue.

As a result of the IGSCC concerns, NRC issued Generic Letter (GL) 94-03, "Intergranular Stress Corrosion Cracking (IGSCC) of Shrouds in Boiling Water Reactors," on July 24, 1994. Among other things in the GL, NRC requested that BWR licensees inspect their core shrouds for cracking at the next scheduled refueling outage and provide the inspection results within 30 days of completing the inspection.

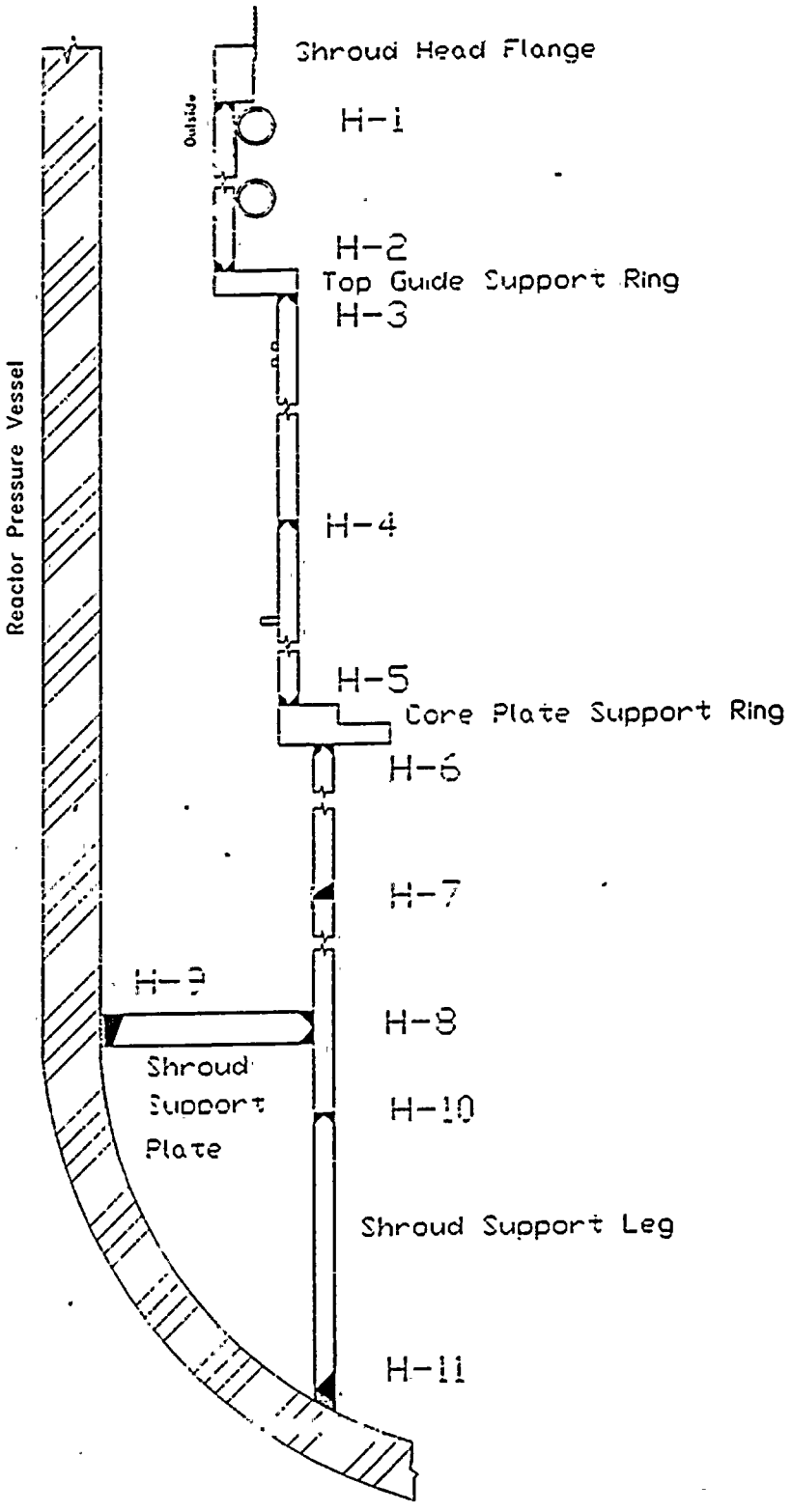
In response to the GL (TVA letter to NRC dated August 23, 1994), TVA committed to inspect 100% of the accessible areas on welds H1 through H7 (see Figure E-1) using the best available non-destructive examination (NDE) technology. The inspections were performed during the BFN Unit 2 Cycle 7 refueling outage that began on October 1, 1994. In addition, TVA's response provided details about the construction of the BFN core shrouds and discussed the risk factors that affect BFN.

II. INSPECTION SUMMARY

TVA and GE inspected 100% of the accessible areas on the Unit 2 core shroud welds H1 through H7 using NDE methods. The inspections were completed on October 22, 1994. The inspections were performed by qualified personnel using the best available technology in accordance with approved BFN procedures. The full inspection report is available on-site for review.

FIGURE E-1

BFN CORE SHROUD CONSTRUCTION DETAILS



Personnel performing the examinations were certified to at least Level II status in accordance with SNT-TC-1A, 1984 Edition. Additionally, personnel performing ultrasonic (UT) examinations were qualified through the Electric Power Research Institute (EPRI) NDE Center in accordance with the Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE Personnel.

Ultrasonic examinations (UT) were performed using the GE Smart-2000 system and suction cup scanners. UT was performed on 100% of the accessible areas on all seven welds. Visual examinations were performed in selected areas to locate obstructions and assist in setting up ultrasonic test equipment.

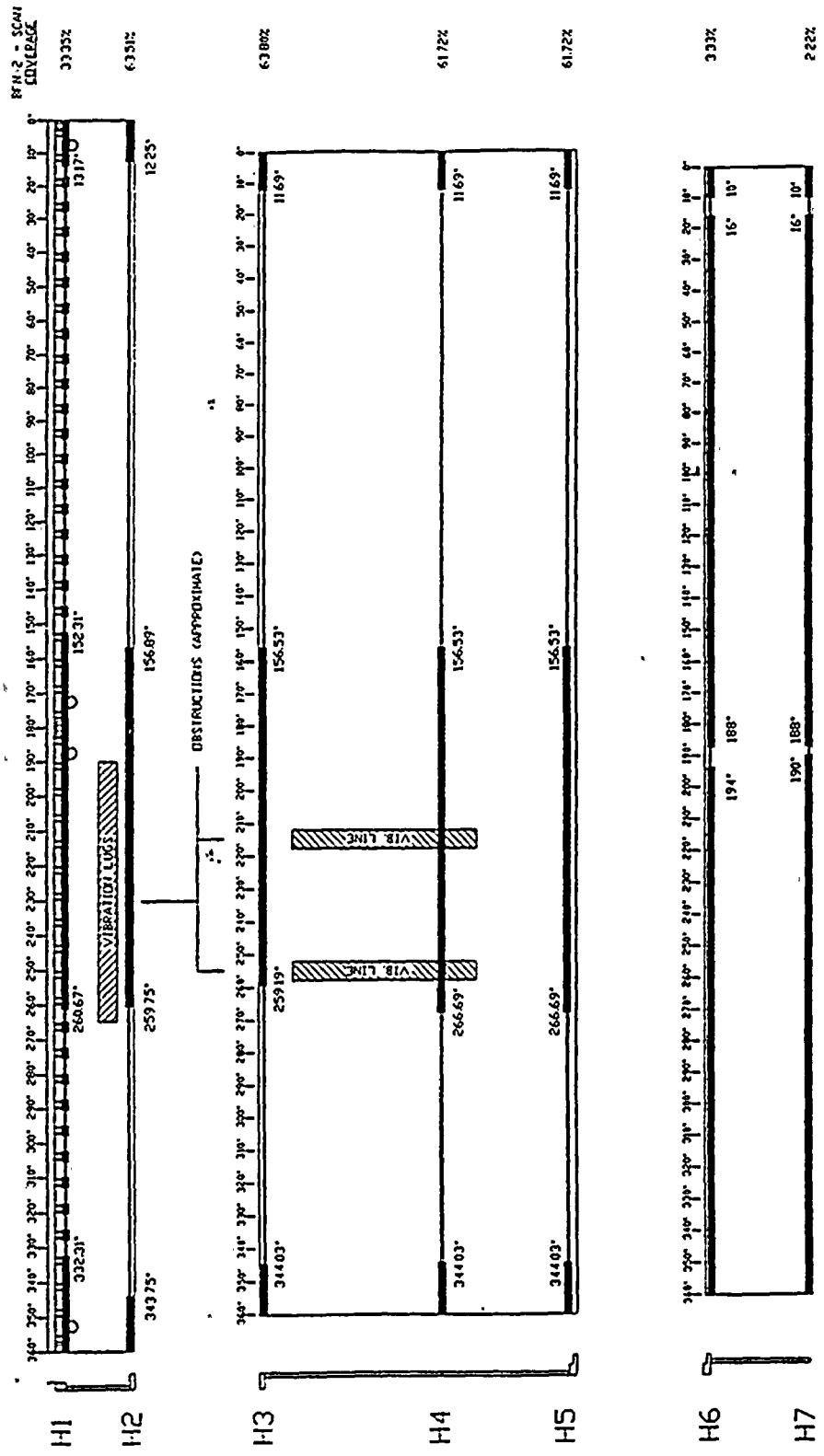
Inspection procedures were prepared to implement the applicable portions of ASME Section V and XI recommendations, the NRC/EPRI/BWROG Coordination Plan, and General Electric (GE) Service Information Letter (SIL)-572. The inspection procedures were approved by TVA.

Accessibility for the inspections was limited due to various equipment or internal structures that restrict access to the welds. The proximity of various components such as guide pins, lifting lugs, core spray downcomers, shroud head locking lugs, jet pump riser braces, and jet pumps precluded further examination. Figure E-2 shows a "roll-out" of the areas inspected. The following provides a summary overview of the amount of each weld TVA examined:

WELD NUMBER	CIRCUMFERENCE EXAMINED (INCHES)	PERCENTAGE EXAMINED
H1	230.50"	33.35%
H2	438.95"	63.51%
H3	415.14"	63.80%
H4	401.60"	61.72%
H5	401.60"	61.72%
H6	21.00"	3.33%
H7	14.00"	2.22%

The amount of examination coverage for welds H1 through H5 varied from that achieved during the BFN Unit 3 shroud inspection. Specifically, coverage for welds H1 through H4 was 5 to 20 percent less while coverage for H5 was 20 percent more than that achieved on Unit 3. These variances from Unit 3 are attributed to the relative difference in location of the interferences's encountered on the Unit 2 shroud. The amount of coverage for welds H6 and H7 was 1 to 2 percent less than that achieved on Unit 3. This variance is attributed to the amount of weld buildup encountered on the H7 weld and the size of the transducer package utilized on the H6 weld.

FIGURE E-2
UNIT 2 INSPECTION RESULTS
(SHADED AREAS INDICATE LOCATIONS NOT SCANNED)



III. INSPECTION RESULTS

The results of the Unit 2 inspection indicate that severe cracking of the core shroud welds is not occurring. During UT inspections, surface connected planar indications were found in three welds (H2, H3, and H5). The flaws were dispersed around the circumference of each weld. There were no through-wall cracks identified. A summary of the Unit 2 inspection results is provided below. The individual Examination Summary Sheets for shroud welds H1 through H7 are provided on pages E-6 through E-12.

WELD NUMBER	INSPECTION TYPE	RESULTS	FLAW TYPE
H1	UT	No reportable indications	N/A
H2	UT	(1) indication 1.34" total length	Planar
H3	UT	(3) indications 9.41" total length	Planar (3)
H4	UT	No reportable indications	N/A
H5	UT	(6) indications 9.09" total length	Planar (6)
H6	UT	No reportable indications	N/A
H7	UT	No reportable indications	N/A

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO.: R-E94-03

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BEN-503V2 REV: 0 FRR: N/A N/A N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A N/A N/A

WELD NO.: H1 (GIRTH WELD)

CONFIGURATION: SHELL TO FLANGE RING

N/A REV: N/A FRR: N/A N/A N/A

EXAMINER: T. ROCKWOOD LEVEL: II

EXAMINER: M. KRUEGER LEVEL: II

EXAMINER: MCKEAN / SWITZER LEVEL: II / II

☐ MT ☐ PT ■ UT ☐ VT

WELD TYPE: ☐ CIRCUMFERENTIAL ☐ LONGITUDINAL ■ OTHER SHROUD

DATA SHEET NO.(S): D-E94-12 / 13 / 14 / 15 / 16

CAL SHEET NO.(S): C-E94-10 / 11 / 12 / 13 / 14 / 15

During the examination of the above referenced weld, no surface connected planar flaws or any indications associated with IGSCC / IASCC were recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units.

The 45° shear wave search unit did record non-relevant indications from both sides of the weld, along with inside and outside surface weld crown geometry, acoustic interface, and inside surface geometry from the lower side of the weld.

The 60° RL search unit recorded non-relevant indications from both sides of the weld, along with inside surface weld crown geometry from the upper side of the weld.

The OD creeping wave search unit recorded only non-relevant indications from both sides of the weld.

This examination was also limited to "L" dimensions of 13° to 17°, 21° to 25°, 28° to 32°, 36° to 40°, 43° to 47°, 51° to 55°, 58° to 62°, 66° to 70°, 73° to 77°, 81° to 85°, 88° to 92°, 96° to 100°, 103° to 107°, 111° to 115°, 118° to 122°, 126° to 130°, 133° to 137°, 141° to 145°, 148° to 152°, 261° to 265°, 268° to 272°, 276° to 280°, 283° to 287°, 291° to 295°, 298° to 302°, 306° to 310°, 313° to 317°, 321° to 325°, 328° to 332°, and 336° to 340° from Vessel "0" due to the proximity of lifting and vibration lugs, top guide pins, and core spray downcomers. Circumferential "L" dimensions for all examination scans were recorded in angular units in lieu of linear units. The conversion factor forcircumferential measurements is 1.92" per degree.

Des Money	III	10.17.94		10/24/94	
SUMMARY BY	LEVEL	DATE	UTILITY REVIEW	DATE	
GE REVIEWED BY	II	10.23.94	N/A	N/A	PAGE: 1 OF: 18
	LEVEL	DATE	ANII REVIEW	DATE	

FORM UT-4B REV. 6

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO.: R-F94-02

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BFN-503V2 REV: 0 FRR: N/A N/A N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A N/A N/A

WELD NO.: H2 (GIRTH WELD)

CONFIGURATION: FLANGE RING TO SHELL

N/A REV: N/A FRR: N/A N/A N/A

EXAMINER: T. ROCKWOOD LEVEL: II

EXAMINER: M. KRUEGER LEVEL: II

EXAMINER: MCKEAN / SWITZER LEVEL: II / II

☐ MT ☐ PT ■ UT ☐ VT

WELD TYPE: ☐ CIRCUMFERENTIAL ☐ LONGITUDINAL ■ OTHER SHROUD

DATA SHEET NO.(S): D-F94-07/ 08 / 09 / 10 / 11

CAL SHEET NO.(S): C-F94-04 / 05 / 06 / 07 / 08 / 09

During the ultrasonic examination of the above referenced weld, one (1) inside surface connected planar flaw indication was recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units. This indication has the following parameters:

Indication Number	Distance From Lo	Total Length*	Remaining Ligament	Thruwall Dimension**	Side of Weld	Type Reflector	Search Unit
1	72.6° / 139.4"	0.7° / 1.34"	1.82"	.18"	Lower	Planar	45°

* Length sizing for indications was determined as the point where the indication signal response was obscured by the baseline noise.

** The throughwall dimension for each indication was determined with the tip diffraction technique using the absolute arrival time sizing method.

The 45° shear also recorded non-relevant indications, inside surface geometry, and inside surface weld crown geometry from both sides of the weld along with acoustic interface, outside surface weld crown geometry, and the one (1) previously referenced planar flaw from the upper side of the weld.

The 60°RL also recorded non-relevant indications, inside surface geometry, and inside surface weld crown geometry from both sides of the weld along with shear component and acoustic interface from the upper side of the weld.

The OD creeping wave search unit recorded only non-relevant indications from both sides of the weld.

This examination was limited to "L" dimensions of 12° to 157° and 260° to 343° from vessel '0' due to the proximity of lifting and vibration lugs, top guide pins, and corespray downcomers. Circumferential "L" dimensions for all examination scans were recorded in angular units in lieu of linear units. The conversion factor for circumferential measurements is 1.92" per degree.

Wes Money	III	10.16.94		10/24/94	
SUMMARY BY	LEVEL	DATE	UTILITY REVIEW	DATE	
GE REVIEWED BY	II	10-23-94	N/A	N/A	PAGE: 1 OF: 26
	LEVEL	DATE	ANII REVIEW	DATE	

FORM UT-68 REV. 6

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO. R-F94-01

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BEN-503V2 REV: 0 FRR: N/A / N/A / N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A / N/A / N/A

WELD NO.: H3 (GIRTH WELD)

CONFIGURATION: SHELL TO FLANGE RING

N/A REV: N/A FRR: N/A / N/A / N/A

EXAMINER: C. MCKEAN LEVEL: II

☐ MT ☐ PT ■ UT ☐ VT

EXAMINER: T. ROCKWOOD LEVEL: II

WELD TYPE: ☐ CIRCUMFERENTIAL ☐ LONGITUDINAL ■ OTHER SHROUD

EXAMINER: W. MONEY LEVEL: III

DATA SHEET NO.(S): D-F94-01 / 02 / 03 / 04 / 05 / 06

CAL SHEET NO.(S): C-F94-01 / 02 / 03

Dunng the ultrasonic examination of the above referenced weld, three (3) inside surface connected planar flaw indications were recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units. These indications have the following parameters:

Indication Number	Distance From Lo	Total Length*	Remaining Ligament	Thruwall Dimension**	Side of Weld	Type Reflector	Search Unit
1	60.7° / 110.4"	1.30° / 1.35"	1.56"	.44" < 50% TW	Lower	Planar	45°/60°
2	270.0° / 488.7"	1.50° / 2.72"	1.45"	.55" < 50% TW	Lower	Planar	45°/60°
3	331.6° / 600.2"	2.40° / 4.34"	1.22"	.78" (See note)	Lower	Planar	45°/60°

* Length sizing for indications was determined as the point where the indication signal response was obscured by the baseline noise

**The throughwall dimension for each indication was determined with the tip diffraction technique using the absolute arrival time sizing method.

Note: Thruwall dimension on indication #3 was determined from the tip signal response which exhibited the most through wall dimension. However, due to the outside surface weld crown geometry the full echo dynamic pattern from the tip signal response could not be acnieved and should be considered a best effort sizing estimation.

The 45° shear also recorded non-relevant indications, beam redirect, inside surface geometry, and inside surface weld crown geometry along with the three (3) previously referenced planar flaws from the lower side of the weld.

The 60°RL also recorded non-relevant indications along with shear component and inside surface geometry from the weld crown, as well as the three (3) previously referenced planar flaws from the lower side of the weld.

The OD creeping wave search unit recorded only non-relevant indications from the lower side of the weld.

No examination was performed from the upper side of the weld due to the component configuration. This examination was limited to "L" dimensions of 13° to 157° and 260° to 344° from vessel '0' due to the proximity of lifting and vibration lugs, top guide pins, and core spray downcomers. Circumferential "L" dimensions for all examination scans were recorded in angular units in lieu of linear units. The conversion factor for circumferential measurements is 1.81" per degree.

Wes Money	III	10.14.94		10/24/94	
SUMMARY BY	LEVEL	DATE	UTILITY REVIEW	DATE	
	III	10/25/94	N/A	N/A	PAGE: 1 OF: 31
GE REVIEWED BY	LEVEL	DATE	ANII REVIEW	DATE	

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO. R-F94-04

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BEN-503V2 REV: 0 FRR: N/A N/A N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A N/A N/A

WELD NO.: H4 (GIRTH WELD)

CONFIGURATION: SHELL TO SHELL

N/A REV: N/A FRR: N/A N/A N/A

EXAMINER: T. ROCKWOOD LEVEL: II

☐ MT ☐ PT ■ UT ☐ VT

EXAMINER: M. KRUEGER LEVEL: II

☐ CIRCUMFERENTIAL

WELD TYPE: ☐ LONGITUDINAL ■ OTHER SHROUD

EXAMINER: MCKEAN / SWITZER LEVEL: II / II

DATA SHEET NO.(S): D-F94-17 / 18 / 19 / 20 / 21

CAL SHEET NO.(S): C-F94-16 / 17 / 18 / 19 / 20 / 21

During the examination of the above referenced weld, no surface connected planar flaws or any indications associated with IGSCC / IASCC wer recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units.

The 45° shear wave search unit did record non-relevant indications and inside surface weld crown geometry from both sides of the weld, along with beam redirect and outside surface weld crown geometry from the upper side, and welding discontinuities from the lower side of the weld.

The 60° RL search unit recorded non-relevant indications, acoustic interface, and shear component from both sides of the weld, along with insid surface weld crown geometry from the upper side, and welding discontinuities from the lower side of the weld.

The OD creeping wave search unit recorded only non-relevant indications from both sides of the weld.

This examination was also limited to "L" dimensions of 12° to 157° and 267° to 344° from Vessel "0" due to the proximity of lifting and vibration lugs, top guide pins, and core spray downcomers. Circumferential "L" dimensions for all examination scans were recorded in angular units in lie of linear units. The conversion factor forcircumferential measurements is 1.81" per degree.

Wes Money	III	10.19.94		10/24/94	
SUMMARY BY	LEVEL	DATE	UTILITY REVIEW	DATE	
GE REVIEWED BY	II	10-23-94	N/A	N/A	PAGE: 1 OF: 25
	LEVEL	DATE	ANII REVIEW	DATE	

FORM UT-09 REV. 5

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO. R-F94-05

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BEN-503V2 REV: 0 FRR: N/A N/A N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A N/A N/A

WELD NO.: H5 (GIRTH WELD)

CONFIGURATION: FLANGE RING TO SHELL

N/A REV: N/A FRR: N/A N/A N/A

EXAMINER: M. KRUEGER LEVEL: II

EXAMINER: T. ROCKWOOD LEVEL: II

EXAMINER: MCKEAN / SWITZER LEVEL: II / II

☐ MT ☐ PT ■ UT ☐ VT

WELD TYPE: ☐ CIRCUMFERENTIAL ☐ LONGITUDINAL ■ OTHER SHROUD

DATA SHEET NO.(S): D-F94-22 / 23 / 24 / 25 / 26

CAL SHEET NO.(S): C-F94-22 / 23 / 24 / 25 / 26 / 27

During the ultrasonic examination of the above referenced weld, six (6) inside surface connected planar flaw indications were recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units. These indications have the following parameters:

Indication Number	Distance From Lo	Total Length*	Remaining Ligament	Thruwall Dimension**	Side of Weld	Type Reflector	Search Unit
1	71.4° / 129.2"	1.10° / 1.99"	1.16"	.84" < 50% TW	Upper	Planar	45°/60°
2	101.7° / 184.1"	.90° / 1.63"	1.04"	.96" (See note)	Upper	Planar	45°/60°
3	103.4° / 187.2"	.60° / 1.09"	1.13"	.87" < 50% TW	Upper	Planar	45°/60°
4	150.9° / 273.1"	1.60° / 2.90"	1.26"	.74" < 50% TW	Upper	Planar	45°/60°
5	335.2° / 606.7"	.51° / .92"	1.89"	.11" < 50% TW	Upper	Planar	45°
6	337.2° / 610.3"	.31° / .56"	1.78"	.22" < 50% TW	Upper	Planar	45°

* Length sizing for indications was determined as the point where the indication signal response was obscured by the baseline noise.

**The throughwall dimension for each indication was determined with the tip diffraction technique using the absolute arrival time sizing method.

Note: Thruwall dimension on indication #2 was determined from the tip signal response which exhibited the most through wall dimension. However, due to the outside surface weld crown geometry the full echo dynamic pattern from the tip signal response could not be achieved and should be considered a best effort sizing estimation.

The 45° shear also recorded non-relevant indications, beam redirect, inside surface weld crown geometry, and weld discontinuities from both sides of the weld along with beam redirect, inside surface geometry, and outside surface weld crown geometry, as well as the six (6) previously referenced planar flaws from the upper side of the weld.

The 60°RL also recorded non-relevant indications and inside surface weld crown geometry from both sides of the weld, along with welding discontinuities from the lower side, as well as shear component and four (4) of the previously referenced planar flaws from the upper side of the weld.

The OD creeping wave search unit recorded non-relevant indications from both sides of the weld, along with welding discontinuities from the lower side of the weld.

This examination was limited to "L" dimensions of 12° to 157° and 267° to 344° from vessel '0' due to the proximity of lifting and vibration lugs, top guide pins, and core spray downcomers. Circumferential "L" dimensions for all examination scans were recorded in angular units in lieu of

SUMMARY BY	III LEVEL	10.21.94 DATE	UTILITY REVIEW	10/24/94 DATE	
GE REVIEWED BY	III LEVEL	10/25/94 DATE	N/A ANII REVIEW	N/A DATE	PAGE: 1 OF: 41

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO. R-F94-06

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BEN-503V2 REV: 0 FRR: N/A N/A N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A N/A N/A

WELD NO.: H6 (GIRTH WELD)

CONFIGURATION: SHELL TO FLANGE RING

N/A REV: N/A FRR: N/A N/A N/A

EXAMINER: C. MCKEAN LEVEL: II

EXAMINER: M. KRUEGER LEVEL: II

EXAMINER: N/A LEVEL: N/A

☐ MT ☐ PT ■ UT ☐ VT

WELD TYPE: ☐ CIRCUMFERENTIAL ☐ LONGITUDINAL ■ OTHER SHROUD

DATA SHEET NO.(S): D-F94-27

CAL SHEET NO.(S): C-F94-28 / 29 / 30

During the examination of the above referenced weld, no surface connected planar flaws or any indications associated with IGSCC / IASCC wer recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units.

The 45° shear, 60° RL, and OD creeping wave search units did record non-relevant indications from the lower side of the weld.

No examination was peformed from the upper side of the weld due to component configuration. This examination was also limited to "L" dimensions of approximately 10° to 16° and 188° to 194° from Vessel "0" due to the proximity of lifting and vibration lugs, top guide pins, Corespray downcomers, Jet pumps and their associated braces and restraint brackets. Circumferential "L" dimensions for all examination scans were recorded in angular units in lieu of linear units. The conversion factor for circumferential measurements is 1.75" per degree.

SUMMARY BY	III LEVEL	10.23.94 DATE	UTILITY REVIEW	10/25/94 DATE	
GE REVIEWED BY	III LEVEL	10/27/94 DATE	N/A ANII REVIEW	N/A DATE	PAGE: 1 OF: 6

FORM UT-40 REV. 6

GE Nuclear Energy

EXAMINATION SUMMARY SHEET

REPORT NO. R-F94-07

PROJECT: BROWNS FERRY NUCLEAR 1ERNW

PROCEDURE: UT-BEN-503V2 REV: 0 FRR: N/A N/A N/A

SYSTEM: SHROUD VESSEL

N/A REV: N/A FRR: N/A N/A N/A

WELD NO.: H7 (GIRTH WELD)

N/A REV: N/A FRR: N/A N/A N/A

CONFIGURATION: SHELL TO SHELL

EXAMINER: C. MCKEAN LEVEL: II

☐ MT ☐ PT ■ UT ☐ VT

EXAMINER: M. KRUEGER LEVEL: II

WELD TYPE: ☐ CIRCUMFERENTIAL ☐ LONGITUDINAL ■ OTHER SHROUD

EXAMINER: N/A LEVEL: N/A

DATA SHEET NO.(S): D-F94-28

CAL SHEET NO.(S): C-F94-31 / 32 / 33

During the examination of the above referenced weld, no surface connected planar flaws or any indications associated with IGSCC / IASCC wer recorded by the Smart 2000 system utilizing 45° shear wave, 60° refracted longitudinal wave, and OD creeping wave search units.

The 45° shear, 60° RL, and OD creeping wave search units did record non-relevant indications from the lower side of the weld.

No examination was peformed from the upper side of the weld due to component configuration. The examination from the lower side of the wel was limited due to the proximity of the outside diameter backing ring and weld build-up area. This examination was also limited to "L" dimension of approximately 10° to 16° and 188° to 190° from Vessel "0" due to the proximity of lifting and vibration lugs, top guide pins, Corespray downcomers, Jet pumps and their associated braces and restraint brackets. Circumferential "L" dimensions for all examination scans were recorded in angular units in lieu of linear units. The conversion factor for circumferential measurements is 1.75" per degree.

[signature] SUMMARY BY	III LEVEL	10-23-94 DATE	[signature] UTILITY REVIEW	10/25/94 DATE	
[signature] GE REVIEWED BY	III LEVEL	10/25/94 DATE	N/A ANII REVIEW	N/A DATE	PAGE: 1 OF: 6

IV. SAFETY ANALYSIS SUMMARY

TVA and GE performed an analysis of the core shroud cracks identified in Unit 2 to show that restart and resumption of operation for at least two cycles would be acceptable. The analysis was based on the fracture mechanics limit load based screening criteria and evaluation techniques applicable to BFN. The analysis reports used for these assessments are available on-site for review.

The screening criteria establishes the allowable flaw lengths for the various girth and axial welds on the core shroud. The evaluation techniques provide guidance for evaluating inspection results. The screening criteria and evaluation techniques are conservative and bound the BFN inspection results since they are based on the presumption that only visual inspections will be conducted. As such, allowable flaw lengths were established assuming that all flaws would be through-wall.

Flaw indications were observed in only three of the seven Unit 2 horizontal shroud welds inspected. The indications in welds H3 and H5 are largest with essentially equal lengths of 9.41 inches and 9.09 inches, respectively, while the indication in weld H2 is only 1.34 inches long. None of the indications were significant enough to warrant evaluation. The H5 weld is in a low fluence area (i.e., below 3.0×10^{20} n/cm^2) so Linear Elastic Fracture Mechanics (LEFM) evaluation techniques are not needed.

TVA examined approximately 61.72% of the H5 weld. In the weld length examined, 2.3% was found to be cracked. TVA considers that any cracks in the unexamined portions of the weld would be similar to those found (e.g., 2.3% of the unexamined weld was assumed to be cracked). The deepest crack had a depth of 0.96 inches and a length of 1.63 inches. The longest continuous crack was 2.9 inches with a maximum depth of 0.74 inches.

An evaluation of the H5 weld was performed to estimate the extent that the cracking may propagate during the next two cycles of operation. ASME Section IX proximity rule (2*flaw depth + 2*flaw growth) was used in evaluating the data since flaw characteristics were determined by UT.

To account for the uncertainty in depth sizing by UT, TVA added 0.3 inches to the flaw depths. The flaw growth rate was estimated using conservative values that have been accepted by NRC (5.0×10^{-05} inches/hour of hot operation).

- A calculation was performed using the evaluation method to determine if the postulated flaw sizes would meet the acceptance criteria through two operational cycle (assumed to be 12,500 hot operating hours per fuel cycle). The results of the evaluation are shown below:

UNIT	DESCRIPTION	CYCLE 9
2	Total On-Line Hours at End of Cycle	107,700
	Total Effective Flaw Length, inches	38
	Allowable Effective Flaw Length, inches	416
	% Margin	86
	Maximum 90° Window Indications Length, inches (for information only)	17
	Allowable 90° Window Indications Length, in	104

V. CONCLUSIONS

Based on the analysis summarized above, TVA considers that it is acceptable to operate Unit 2 through the Cycle 9 operating cycle. The results of the inspection confirm that cracking in the Unit 2 core shroud welds is limited and does not pose significant near term concern for structural integrity. This conclusion is based on a significant indicated margin (approximately 90 percent margin of safety after one operating) which in turn is conservatively established.