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RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards summary rept of 10-yr inservice insp of reactor vessel welds.Requisite rept will be filed within 90 days of completion of inservice insp.

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POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

December 2, 1981

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. J. F. Stolz, Chief
Operating Reactors Branch No. 4

Subject: Oconee Nuclear Station, Unit 1
Docket No. 50-269

Dear Sir:

Attached please find a summary report of the 10-year inservice inspection of reactor vessel welds at Oconee Nuclear Station, Unit 1.

This report is provided for informational purposes prior to the submittal of the requisite report which will be filed within 90 days of the completion of the inservice inspection.

Very truly yours,

William O. Parker, Jr.

RLG/php
Attachment

cc: Mr. James P. O'Reilly, Director
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

A047
S
1/1

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
UNIT 1

Summary Report of the 10-Year Inservice Inspection of Reactor Vessel Welds

Duke Power Company
Oconee Nuclear Station
Unit 1

Summary Report of the 10-Year Inservice Inspection
Reactor Vessel Welds

Introduction

This report summarizes the 10-year inservice inspection (ISI) of the reactor vessel welds at Duke Power Company's Oconee Unit #1 Nuclear Station. The inspection was performed during July and August of 1981. The reactor vessel weld inspection is only a portion of the total 10-year ISI that is being conducted. The full report will be provided following completion. Additional details of the examination results are maintained in the Duke corporate offices.

Background

The 10-year ISI of Oconee 1 was in the planning stage for many months prior to the start of the outage. In early 1981, significant efforts were started to support the inspection of the Oconee 1 vessel. Regulatory concerns relative to reactor vessel pressurized thermal shock were present as well as a draft Regulatory Guide addressing the ultrasonic testing of reactor vessel welds.

With regard to reactor vessel pressurized thermal shock, Duke decided to conduct a vessel examination that would reliably indicate the structural integrity of the beltline region welds. Further, being aware of the draft regulatory guide and its schedule for issuance, Duke determined that the requirements of the guide should be addressed and implemented where practical and technically justifiable. To this end, after several meetings with B&W, the Oconee NSSS vendor and reactor vessel examiner, Duke met with the NRC on March 24, 1981 to discuss the proposed inservice inspection of the Oconee 1 reactor vessel. The results of the meeting were used in the preparation of the final inspection plan which is described in the next section.

Examination Plan

The Oconee Unit 1 reactor vessel examination was performed in accordance with the requirements of the 1977 Edition of the ASME Boiler and Pressure Vessel Code, Section V, Article 4 with Addenda through the Summer of 1978. The recommendations of Regulatory Guide 1.150 "Ultrasonic Testing of Reactor Vessel Welds during Preservice and Inservice Examinations" were also satisfied to the extent possible, considering hardware, schedule, and engineering concerns.

The weld volume examined meets or exceeds the minimum requirements of the 1974 Edition of Section XI of the ASME Boiler and Pressure Vessel Code with Addenda through the Summer of 1975. The reactor vessel welds were prioritized

in order to ensure that the minimum Code required examination would be performed and that the maximum lead time would be available in the event a flaw was detected which required a fracture mechanics analysis. A total of two outlet, four inlet, and two core flood nozzle to vessel welds and nozzle inside radius sections were examined 100% of the weld length. All six of the longitudinal welds were examined 100% of the weld length, and five of the seven circumferential welds were examined 100% of the weld length. The two exceptions were the lower head to dutchman weld, which is located in the lower head, and the upper nozzle belt to lower nozzle belt, which is located in the center of the nozzle belt. Only 5% of these weld lengths were examined.

These examinations were performed using the Automated Reactor Inspection System (ARIS) tool (See Figure 1). An additional circumferential weld located in the reactor vessel closure head was also examined; however, conventional manual contact examination techniques were used on this weld and 43% of the length was examined.

Special emphasis was directed to flaw detection at the I.D. surface. The ARIS inspection tool utilizes immersion ultrasonic examination techniques, whereby many of the variables which usually limit or preclude an effective examination of the near surface (I.D.) can be eliminated. The techniques used for this examination provide qualified sensitivity to reliably detect flaw sizes consistent with those identified in the acceptance standards of IWB-3500 of ASME Section XI. The area examined with the near surface technique on each side of the weld was approximately equal to 1.8T when scanning perpendicular to the weld and .75T when scanning parallel to the weld (see Figure 2). This is substantially more than required by Code and, in the beltline region, amounts to approximately 60% of the total surface area.

Figures 3 and 4 identify the reactor vessel and closure head welds examined in accordance with Regulatory Guide 1.150. Each weld location number identified in these figures corresponds to a figure and weld identification number as identified in Table 1, Weld Examination Summary Evaluation reports, included in Appendix A, which are referenced by a specific figure number for each weld.

Examination Results

A total of 133 indications were recorded, all of which were acceptable to the Section XI evaluation criteria. Of the 133 indications recorded, 114 were laminar reflectors.[1] The remaining indications were comprised of 16 seventy degree and 3 sixty degree reflectors. The 114 laminar indications were less than 16% of the allowable limit of Table IWB-3510.2 of Section XI.

---

[1] An indication is considered to be laminar if it is oriented on a plane within 10 degrees of being parallel to the component surface.

The 16 seventy degree indications are manufacturing-induced slag inclusions, all of which were located in the clad material applied following removal of the mid shell to lower shell circumferential weld backing ring. Since the clad is not considered as part of the pressure retaining boundary of the component, no Section XI evaluation is required for these indications. A precautionary evaluation was performed, however, at the time of examination as it was not known for sure that the indications were located in the clad since they occurred at a depth slightly greater than the nominal clad thickness. These indications ranged from 8.46% to 94.3% of the Section XI acceptance criteria. It was later determined that the clad was thicker in the areas where the backing rings had been removed and that the indications were located in the clad as mentioned previously.

The 3 sixty degree indications were subsurface reflectors and could be correlated to baseline reflectors in the same general area. These indications are planar flaws[2] which do not exceed the Section XI acceptance criteria. A detailed evaluation of the 3 sixty degree indications referencing size and location is shown in Figures 5 and 6.

The 70^{o} flaw sizing techniques used were applied to a calibration notch which is 0.20 inches in the through wall direction, starting at the clad-base metal interface and penetrating into the base material. The notch is perpendicular to the clad surface of the calibration block. The results are that at 50% DAC, the recorded size of the simulated flaw is 0.25 inches. This represents a recorded dimension 25% greater than actual flaw size. At 20% DAC, the recorded size of the simulated flaw is 0.60 inches, which represents a recorded size 300% greater than actual flaw size. The data suggests that indications sized to the examination technique are conservative measurements and actual flaw size would be less than the recorded flaw size.

A complete correlation was not made between the observed indications and the baseline data due to the many differences in test variables between the type of examination performed for the baseline and that performed during this examination. The major variables include the manual contact examination technique versus automatic immersion technique; baseline examination requirements versus current examination requirements; and calibration blocks used for baseline versus calibration blocks used for this examination.

Summary

All of the indications recorded during the examination were evaluated to be manufacturing-induced and are less than the maximum allowable flaw size specified by the acceptance standards of IWB-3500 of Section XI. Based on the examination performed, there is no evidence of any service-induced flaw in the Oconee Unit 1 vessel. Specifically, the examination has provided a high degree of confidence in the beltline region in that there are no surface flaws in the pressure retaining material that exceed 0.15 inches.

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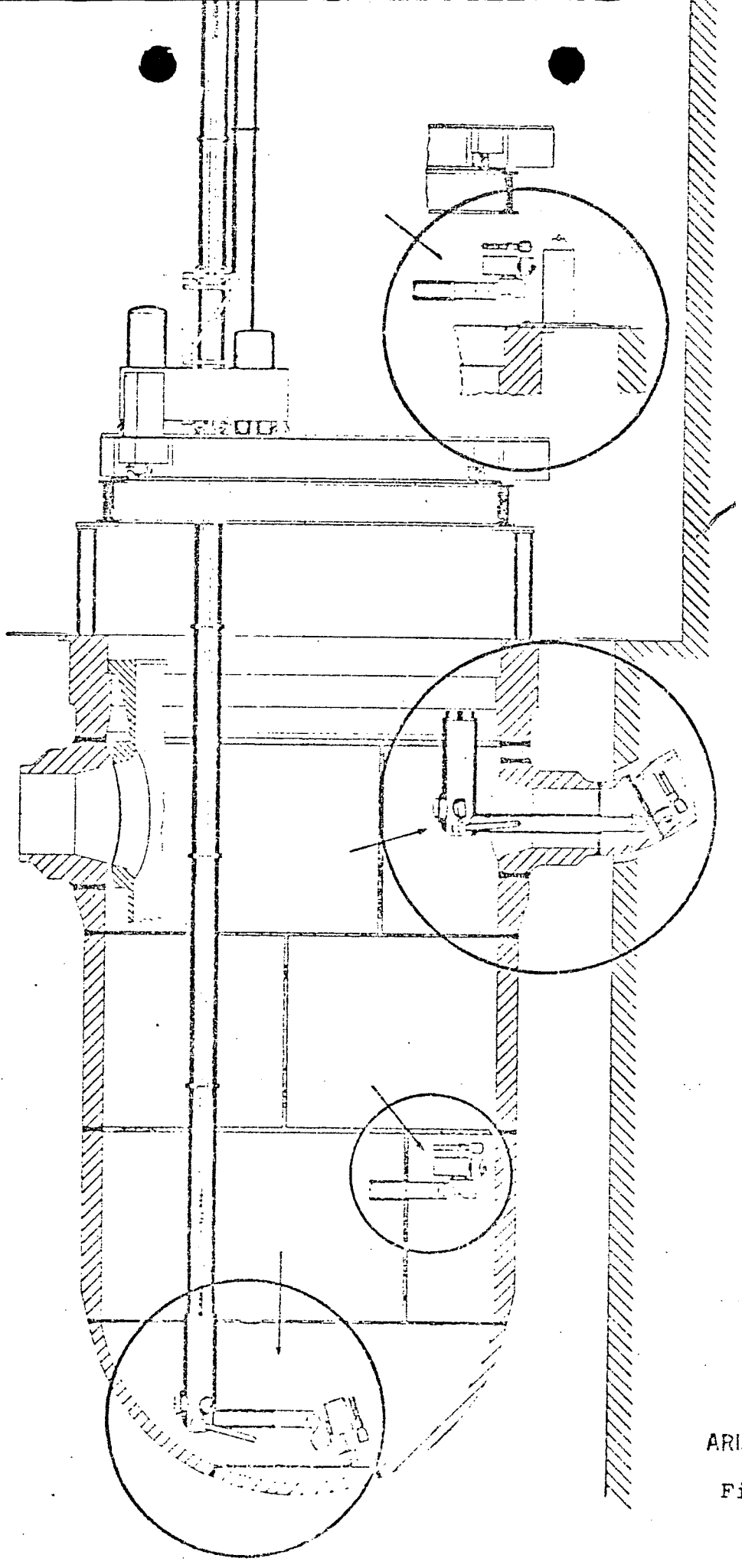
[2] An indication is considered planar if it is oriented in a single plane, other than parallel to the surface of the component.

TABLE 1
WELD EXAMINATION SUMMARY

Weld	Number of Flaw Indications Laminar/Slag/Planar	Figure Number *
1. Upper Nozzle Belt to Flange-Circle	None	B1.03.001
2. Upper Nozzle Belt to Lower Nozzle Belt-Circle	None	B1.02.001
3. Lower Nozzle Belt to Upper Shell-Circle	49/0/0	B1.01.009
4. Upper Shell to Mid-Shell-Circle	10/0/0	B1.01.006
5. Mid-Shell to Lower Shell-Circle	9/16/3	B1.01.003
6. Lower Shell to Dutchman-Circle	None	B1.02.002
7. Dutchman to Lower Head-Circle	None	B1.02.003
8. Upper Shell-Longitudinal	None	B1.01.007
8A. Upper Shell-Longitudinal	None	B1.01.008
9. Mid-Shell-Longitudinal	25/0/0	B1.01.004
9A. Mid-Shell-Longitudinal	None	B1.01.005
10. Lower Shell-Longitudinal	None	B1.01.001
10A. Lower Shell-Longitudinal	21/0/0	B1.01.002
11. Core Flood Nozzle (2)	None	B1.04.007, .008
12. Hot Leg Nozzle (2)	None	B1.04.001, .002
13. Cold Leg Nozzle (4)	None	B1.04.003, .004, .005, .006
14. Flange to Closure Head	None	B1.03.002

* Refer to supporting documents included in Appendix A.



ARIS II manipulator

Figure 1

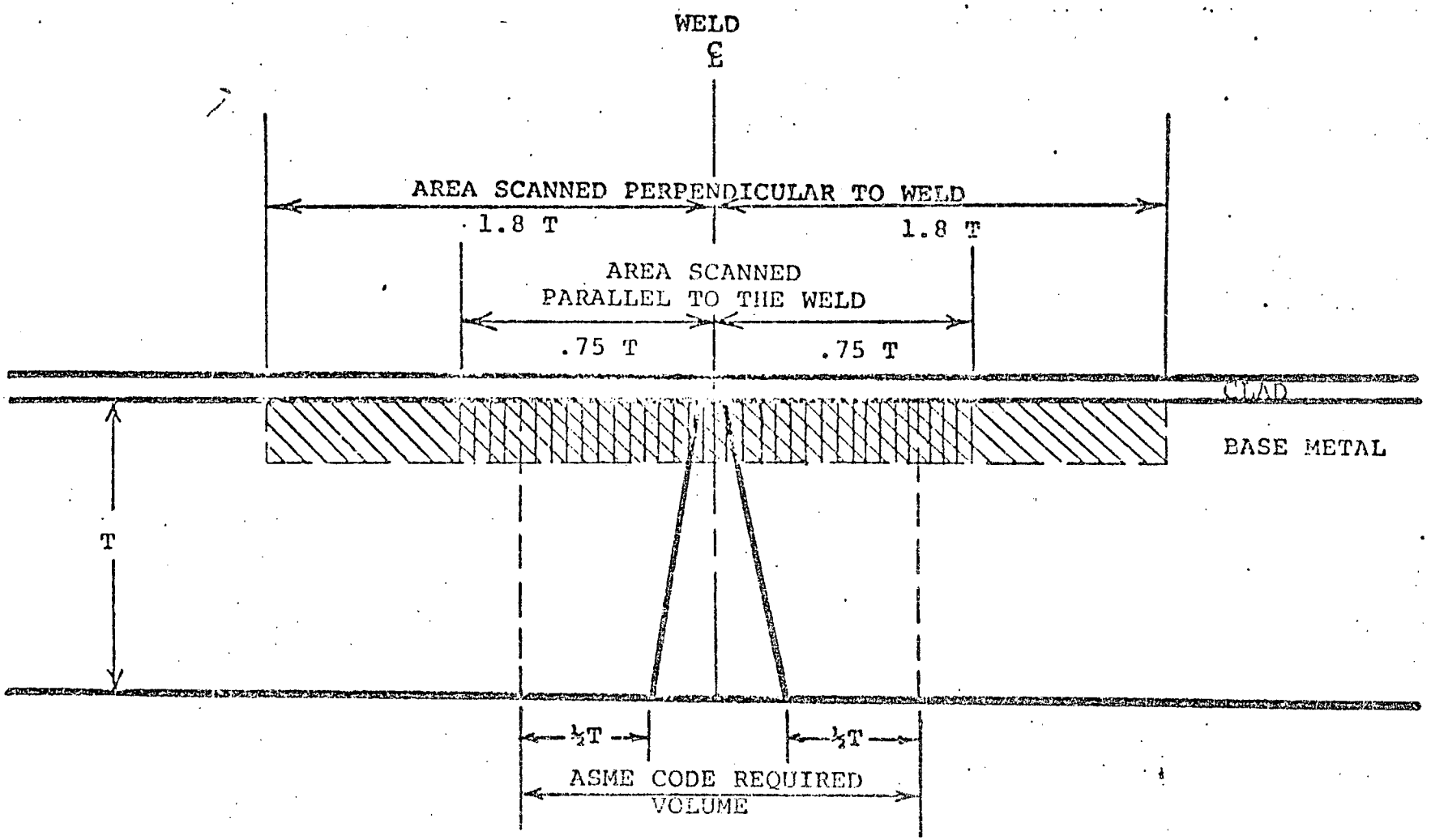


FIGURE 2

TYPICAL AREA SCANNED WITH NEAR SURFACE TECHNIQUE

OCONEE-1 REACTOR VESSEL

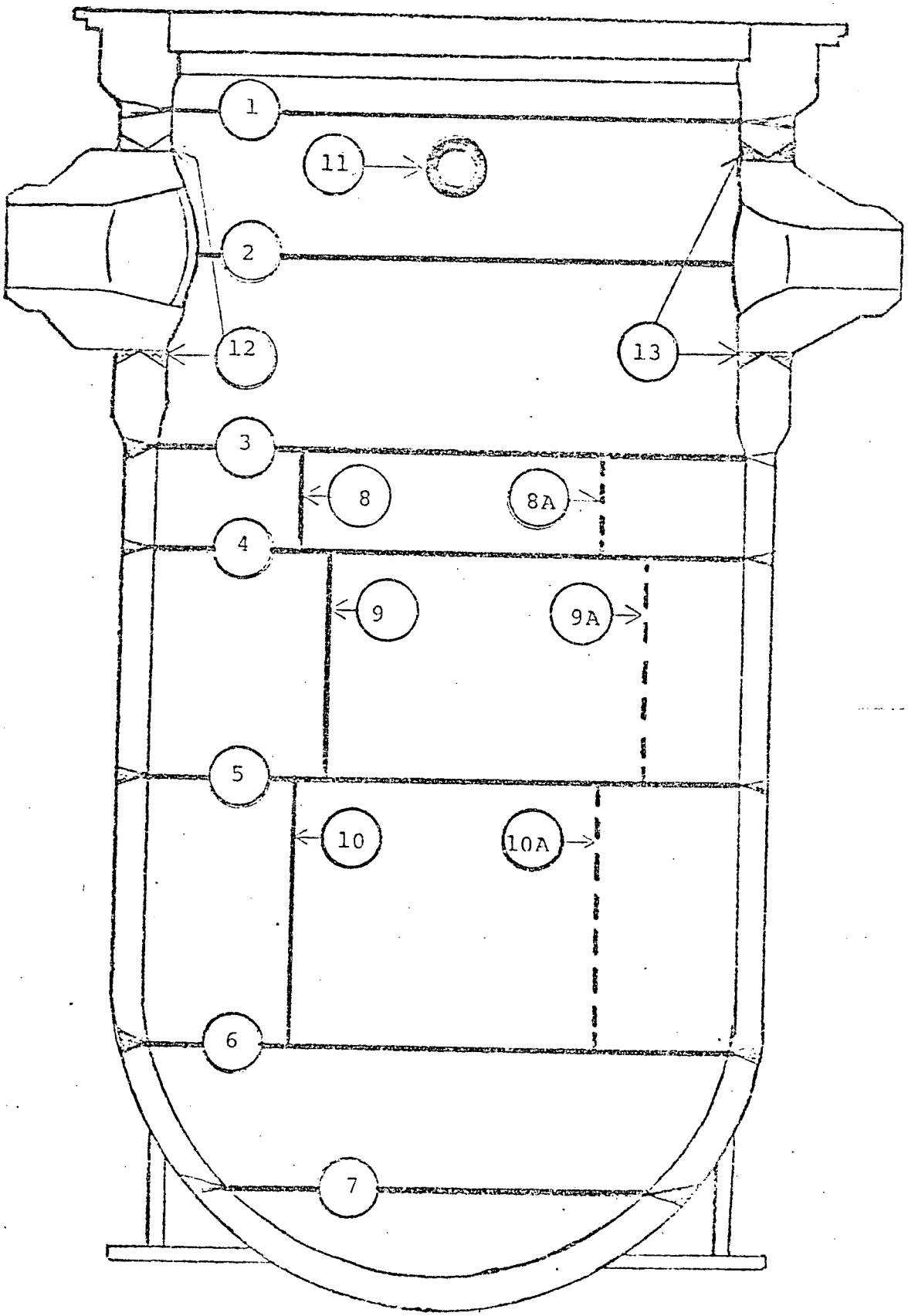


Figure 3

REACTOR VESSEL CLOSURE HEAD

OCONEE-1

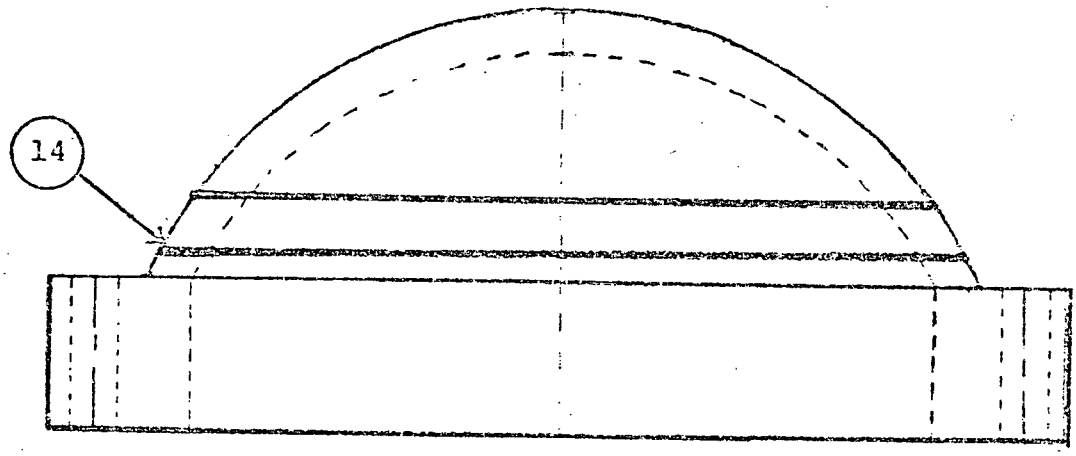


Figure 4

WELD #1RPV-WR1 EVALUATION

(FIGURE #B1.01.003)

INDICATION	S	L	a	2a	a/L	t	a/t
#400	1.05	.45	.25	.50	.50*	9	2.77%
#401	.78	1.50	.19	.38	.13	9	2.11%
#402	.90	.75	.19	.38	.25	9	2.11%

*Actual aspect ratio exceeds .50

$S \leq a$ ---Surface flaw

$S > a$ ---Subsurface flaw

The values for S,L,a,2a, and t are in inches.

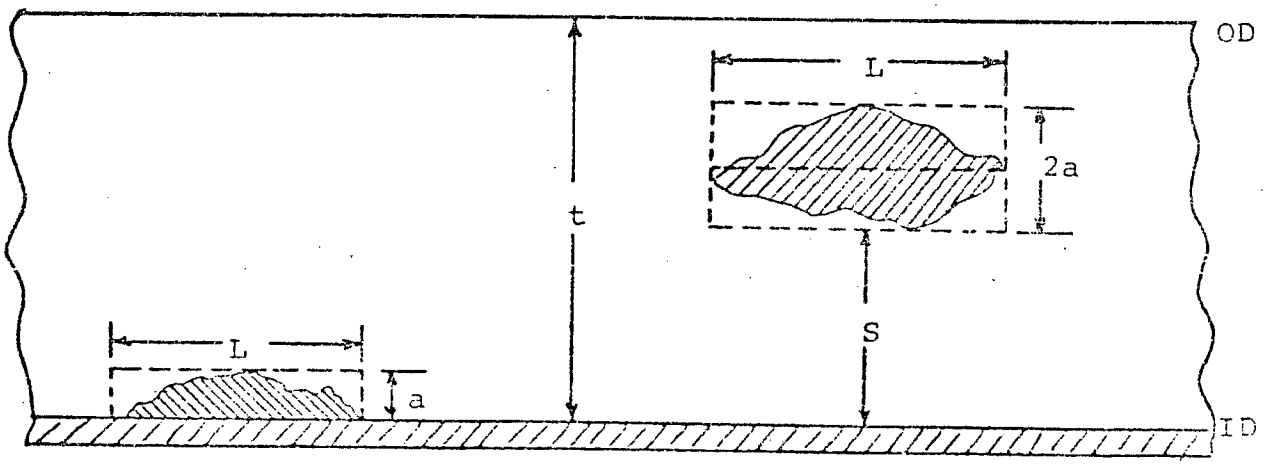
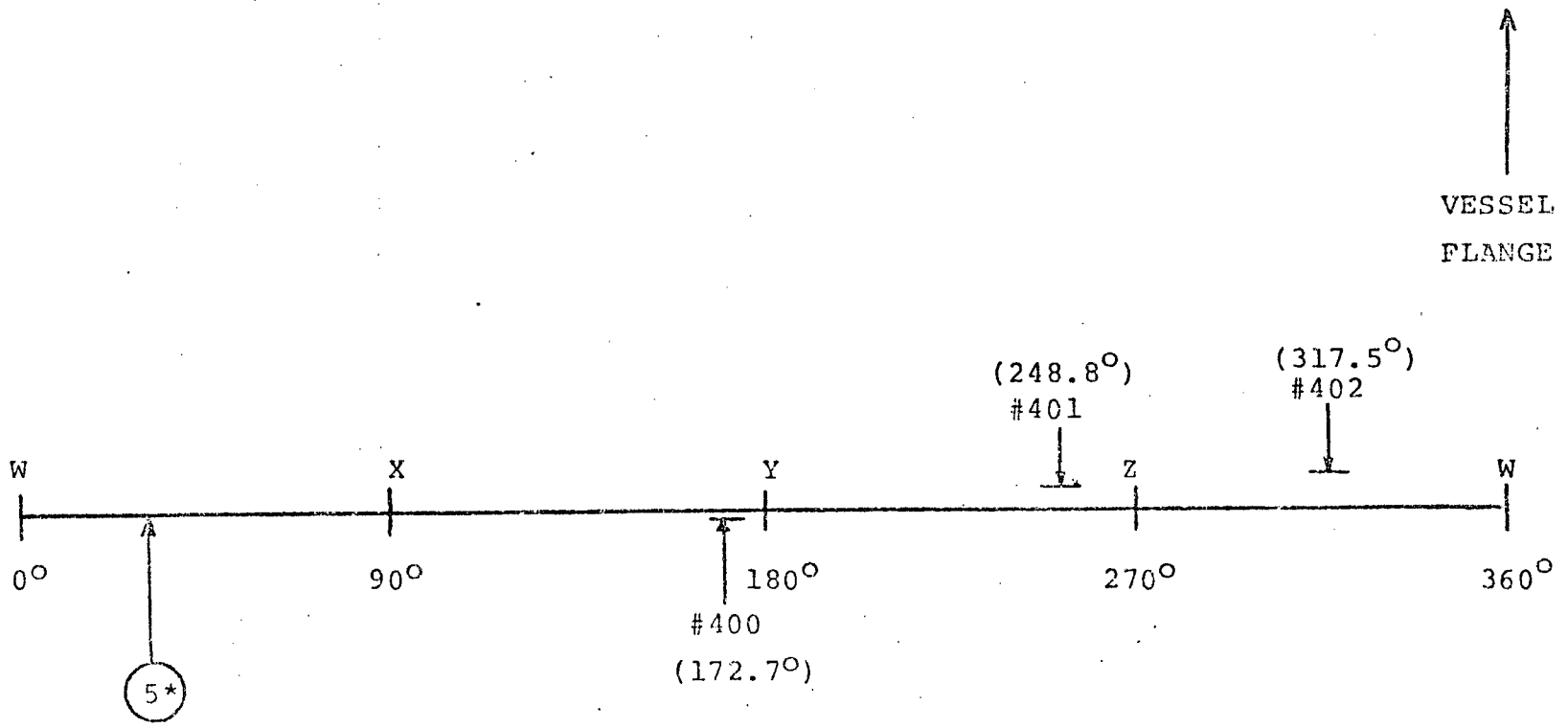


FIGURE 5

FIGURE 6



* Solid line represents the weld centerline. 5 corresponds to the identification shown in Figure 5 and in Table 1.

Indication #400 is approximately .1 inch from the weld centerline.
Indication #401 is approximately .2 inch from the weld centerline.
Indication #402 is approximately .3 inch from the weld centerline.

Appendix A

EXAMINATION SUMMARY

Figure or Item No.	Examination Status: Recordable Yes	Recordable No	Indication Number(s)	Evaluation Report No.	Results	Limited Exam Yes	Limited Exam No	Remarks
B1.01.001		X				X		Limited exam for all angles due to guide lug near lower length of weld at 120°.
B1.01.002	X		001 thru 021	81-161	Acceptable		X	All indications are laminar reflectors of acceptable size.
B1.01.003	X		001 thru 009 400 thru 402 600 thru 615	81-162	Acceptable		X	001 thru 009 are zero degree indications which are laminar reflectors of acceptable size. Indications 400, 401, 402, and 600 thru 615 are also reflectors of acceptable size.
B1.01.004	X		001 thru 025	81-163	Acceptable		X	All indications are laminar reflectors of acceptable size.
B1.01.005		X					X	
B1.01.006	X		001 thru 010	81-164	Acceptable		X	All of the indications recorded are laminar reflectors of acceptable size.
B1.01.007		X					X	
B1.01.008		X					X	

EXAMINATION SUMMARY

Figure or Item No.	Examination Status: Recordable Yes	Examination Status: Recordable No	Indication Number(s)	Evaluation Report No.	Results	Limited Exam Yes	Limited Exam No	Remarks
B1.01.009	X		001 thru 049	81-165	Acceptable	X		All of the indications recorded are laminar reflectors of acceptable size. A limited exam was due to the nozzle belt transition.
B1.02.001		X					X	
B1.02.002		X				X		Limited exam due to 12 guide lugs and 12 flow stabilizers.
B.1.02.003		X				X		Limited exam due to 12 flaw stabilizers and instrumentation nozzles.
B1.03.001		X				X		This examination was limited due to the taper and flange configuration.
B1.03.002		X				X		No exam between positions 25 and 1 due to the head to flange configuration on surface 2. No exam between positions 25 and 1 due to the service structure attachments on surface 1. No exam between positions 34 and 36 due to lifting lug attachment. No exam between positions 41 and 2 due to "W" axis indicator.

EXAMINATION SUMMARY

Figure or Item No.	Examination Status					Limited Exam		Remarks
	Recordable		Indication Number(s)	Evaluation Report No.	Results			
	Yes	No				Yes	No	
B1.04.001		X					X	
B1.04.002		X					X	
B1.04.003		X					X	
B1.04.004		X					X	
B1.04.005		X					X	
B1.04.006		X					X	
B1.04.007		X					X	
B1.04.008		X					X	

INSERVICE INSPECTION

VOLUMETRIC EXAMINATION EVALUATION REPORT

EVALUATION NUMBER: 81-161

METHOD: UT X RT ____

FILE NO. OR DISPOSITION: [illegible]

COMPLETED BY B&W 151:

PROCEDURE 151-111 REV. 1

WELD NO. OR IDENTIFICATION 1RPV-A2-WR2A Long Seam Z-W axis. A2 to A2

APPLICABLE CODE YEAR AND ADDENDA ASME, B&PV Code, Section XI, 1974 Edition Through Summer 1975 Addenda

DATE OF EXAMINATION 8-8-81 thru 8-10-81

ADDITIONAL INFORMATION ____

ORIGINATOR: Paul L. Pitz LEVEL: II DATE: September 9, 1981

COMPLETED BY TECHNICAL:

ACCEPTANCE STANDARD IWB-3510

COMMENTS Indications #001, 002, 003, 004, 005, 006, 007, 008, 009, 010, 011, 012, 013, 014, 016, 018, 019, 020, and 021 are laminar indications and represent the lamination dimension to determine angle beam examination interference. None of the above are of significant size to adversely limit the angle beam examinations. Indication #015 and #017 are laminations of acceptable size.

✓ ACCEPTABLE ____ REJECTABLE (IF SO, CUSTOMER RESPONSE REQUIRED)

LEVEL III: M. G. Hocher DATE: September 9, 1981

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FIGURE NO. R1.01.002

BABCOCK & W. .OX

INSERVICE INSPECTION

VOLUMETRIC EXAMINATION EVALUATION REPORT .

EVALUATION NUMBER	METHOD: UT X RT	FILE NO. CO OPERATIVE
81-162		0441-N.046

COMPLETED BY B&W ISI:

PROCEDURE 1SI-131 REV. 6

WELD NO. OR IDENTIFICATION 1 RPV WR-1 Circle seam, A1 to A2

APPLICABLE CODE YEAR AND ADDENDA ASME, B&PV Code, Section XI, 1974 Edition through Summer 1975 Addenda

DATE OF EXAMINATION 8-6-81 thru 8-9-81

ADDITIONAL INFORMATION

ORIGINATOR: Paul L. Pitz LEVEL: II DATE: September 9, 1981

COMPLETED BY TECHNICAL:

ACCEPTANCE STANDARD IWB-3510

COMMENTS Indications #001, 002, 003, 004, 005, 006 and 008 are laminations of acceptable size. Indications #007 and 009 are laminar indications and represent the lamination dimension to determine angle beam examination interference. These indications are not of significant size to adversely limit the angle beam examination. Indications #400, 401, and 402 are characterized as sporadic subsurface planar flaws and are of acceptable size. Indications #600 through 615 are not within the measure retaining boundary of the volume and were recorded for information only. All recorded indications are of acceptable size.

X ACCEPTABLE ____ REJECTABLE (IF SO, CUSTOMER RESPONSE REQUIRED)

LEVEL III: M. G. Hacker DATE: September 9, 1981

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FIGURE NO. B1.01.003

BABCOCK & WILCOX
INSERVICE INSPECTION
VOLUMETRIC EXAMINATION EVALUATION REPORT

EVALUATION NUMBER: B1-163

METHOD: UT X RT ____

FILE NO. OR REFERENCE: 0441-B.046

COMPLETED BY B&W ISI:

PROCEDURE ISI-131 REV. 6

WELD NO. OR IDENTIFICATION 1RPV A1-WR2 Long Seam X-Y axis A1 to A1

APPLICABLE CODE YEAR AND ADDENDA ASME, B&PV Code, Section XI, 1974 Edition through Summer 1975 Addenda.

DATE OF EXAMINATION 8-9-81

ADDITIONAL INFORMATION

ORIGINATOR: Paul L. Fitz LEVEL: II DATE: September 9, 1981

COMPLETED BY TECHNICAL:

ACCEPTANCE STANDARD IWB-3510

COMMENTS Indications #001, 003, 004, 005, 006, 007, 008, 009, 010, 011, 013, 014, 015, 016, 017, 018, 019, 020, 021, 022, 023, 025 are laminar indications and represent the examination dimension to determine angle beam examination interference. None of the above are significant size to adversely limit the angle beam examination. Indications #002, 012, and 024 are laminations of acceptable size.

✓ ACCEPTABLE ____ REJECTABLE (IF SO, CUSTOMER RESPONSE REQUIRED)

LEVEL III: M. G. Hacker DATE: September 9, 1981

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FIGURE NO. B1.01.004

EVALUATION NO.
#1- 1644

VOLUMETRIC EXAMINATION EVALUATION REPORT

METHOD: UT X RT ____

FILE NO. TO ATTACH
6441-B.046

COMPLETED BY B&W 131:

WELD NO. OR IDENTIFICATION 1RPV WR-1A Circle seam A1 & 10

PROCEDURE 131-111 REV. 6

APPLICABLE CODE YEAR AND ADDENDA ASME, B&PV Code, Section XI, 1974 Edition through Summer 1975 Addenda

DATE OF EXAMINATION 8-3-81 thru 8-5-81

ADDITIONAL INFORMATION

ORIGINATOR: Paul L. Pitz LEVEL: II DATE: September 9, 1981

COMPLETED BY TECHNICAL:

ACCEPTANCE STANDARD IWB-3510

COMMENTS Indications #001, 003, 005, 007, 008, 009 are laminar indications and represent the lamination dimension to determine angle beam examination interpretance. Indications #002, 004, 006, 010 are laminations of acceptable size.

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FIGURE NO.
B1.01.006

INSERVICE INSPECTION

VOLUMETRIC EXAMINATION EVALUATION REPORT

METHOD: UT X RT ——

RI- 11.5

FILE NO. OR REFERENCE: 0441-N.046

COMPLETED BY B&W ISI:

PROCEDURE ISI-131 REV. 6

WELD NO. OR IDENTIFICATION 1 RPV WR-17 Circle seam 09 to 10

APPLICABLE CODE YEAR AND ADDENDA ASME, B&PV Code, Section XI, 1974 Edition through Summer 1975 Addenda.

DATE OF EXAMINATION 8-5-81 & 8-6-81

ADDITIONAL INFORMATION

ORIGINATOR: Paul L. Pitz LEVEL: II DATE: September 9, 1981

COMPLETED BY TECHNICAL:

ACCEPTANCE STANDARD IWB-3510

COMMENTS Indications # 001, 003, 004, 005, 007, 009, 010, 012, 014, 016, 018, 020, 021, 023, 024, 025, 026, 028, 029, 031, 032, 034, 035, 036, 039, 040, 042, 044, 046, 047, 049 are laminar indications and represent the lamination dimension to determine angle beam examination interference. Indications # 002, 006, 008, 011, 013, 015, 017, 019, 022, 027, 030, 033, 037, 039, 041, 043, 045 and 048 are laminations of acceptable size.

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FIGURE NO. B1.01.009