Omaha Public Power District

444 South 16th Street Mall
Omaha NE 68102-2247

November 21, 2003
LIC-03-0154

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References:
1. Docket No. 50-285
2. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1989 Edition and 1998 Edition through 2000 Addendum
3. ASME Section XI, Appendix VIII
4. Letter from OPPD (R. L. Phelps) to NRC (DCD), Relief Request Pertaining to Reactor Vessel Nozzle Inspections for Third 10-Year Interval, Dated October 22, 2003 (LIC-03-0146)

SUBJECT: Relief Request Pertaining to Reactor Vessel Nozzle Inspections for Third 10-Year Interval, Revision

This letter revises and replaces Reference 4 in its entirety. In Reference 4 OPPD indicated that we would provide the non-proprietary versions of the information needed for the subject relief requests by November 24, 2003. This submittal fulfills that statement.

In accordance with 10 CFR 50.55a(a)(3)(i), FCS is requesting relief for the third ten-year interval from inservice inspection requirements of the 1989 Edition no Addenda, Section XI of the ASME Boiler and Pressure Vessel Code for the surface examination of Class 1, Reactor Pressure Vessel (RPV) nozzle-to-safe end welds. The examination requirement is for a surface and volumetric examination of ASME Section XI, Examination Category B-F, "Pressure Retaining Dissimilar Metal Welds", Item No. B5.10, "Reactor Vessel NPS 4 or Larger."

FCS proposes to implement the requirements consistent with ASME Code Case N-615, "Ultrasonic Examination as a Surface Examination Method for Category B-F and B-J Piping Welds." FCS would implement the Code Case N-615 for the surface examinations for the six (6) Reactor Pressure Vessel nozzle-to-safe end dissimilar metal welds, category B-F, item B5.10 for nozzle inspections performed during the 2003 refueling outage.

Pursuant to 10 CFR 2.790, OPPD requests that the proprietary information herein be withheld from public disclosure. Framatome ANP, INC. considers this information to be proprietary as justified in the supporting affidavit (Attachment B). Attachments C and D are the proprietary Framatome documents, including a copy with the proprietary information annotated (i.e., a clean

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copy and an annotated copy). Attachments E and F are the non-proprietary (redacted) versions of Attachments C and D with the proprietary information deleted.

FCS requests approval of the proposed Relief Request, RR-9, by May 15, 2004.

Commitments made to the NRC in this letter are listed in Attachment G. If you have any questions or require additional information, please contact Dr. R. L. Jaworski at (402) 533-6833.

Sincerely,

R. T. Ridenoure
Division Manager
Nuclear Operations

RTR/RLJ/rrl

Attachments:
A) Fort Calhoun Station Relief Request
B) Affidivit from Framatome ANP, Inc. Supporting Proprietary Nature of Referenced Documents
C) Proprietary Versions of Framatome Report 54-PQ-189-01, Results from ID & OD Clad Safe-end Mockup Block Demonstration for Fort Calhoun
D) Proprietary Versions of Framatome Procedure Number 54-ISI-189-00 ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws
E) Non-Proprietary Version of Framatome Report 54-PQ-189-01, Results from ID & OD Clad Safe-end Mockup Block Demonstration for Fort Calhoun
F) Non-Proprietary Version of Framatome Procedure Number 54-ISI-189-00 ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws
G) Commitment Summary

c:
B. S. Mallett, NRC Regional Administrator, Region IV (w/o attachments)
A. B. Wang, NRC Project Manager
J. G. Kramer, NRC Senior Resident Inspector (w/o attachments)

ATTACHMENT A

Fort Calhoun Station
Relief Request

Use of Code Case N-615
Surface Examination Method
for
RPV Nozzle-to-Safe End Welds

ISI Relief Request RR-9

Use of Code Case N-615 Surface Examination Method for RPV Nozzle-to-Safe End Welds

System: Reactor Vessel **Class 1**
Category: B-F **Item No.: B5.10**

ALTERNATIVE EXAMINATION REQUIREMENTS:

In accordance with 10 CFR 50.55a(a)(3)(i), FCS is requesting relief for the third ten-year interval from inservice inspection requirements of the 1989 Edition no Addenda, Section XI of the ASME Boiler and Pressure Vessel Code for the surface examination of Class 1, Reactor Pressure Vessel (RPV) nozzle-to-safe end welds. The examination requirement is for a surface and volumetric examination of ASME Section XI, Examination Category B-F, "Pressure Retaining Dissimilar Metal Welds", Item No. B5.10, "Reactor Vessel NPS 4 or Larger."

FCS proposes to implement the requirements consistent with ASME Code Case N-615, "Ultrasonic Examination as a Surface Examination Method for Category B-F and B-J Piping Welds." FCS would implement the Code Case N-615 for the surface examinations for the six (6) Reactor Pressure Vessel nozzle-to-safe end dissimilar metal welds, category B-F, item B5.10 for nozzle inspections performed during the 2003 refueling outage.

JUSTIFICATION FOR GRANTING RELIEF

The Ultrasonic examination techniques utilized for this examination are qualified by demonstration to meet the requirements of Code Case N-615. The use of these qualified techniques assures that the dissimilar metal welds remain free of service related flaws thus enhancing quality and ensuring plant safety and reliability.

The work required to support these surface examinations without implementing Code Case N-615 includes labor to remove/replace the cover plates over the six (6) reactor nozzles, and labor to remove/replace the sand above the nozzles. The surface inspections of the outside weld surfaces are limited due to the tight space and no access to the very bottom of the welds. The area dose rate is estimated to be about 120 mr/hr with the head on. The dose in the cavity surrounding the nozzles is unknown. An ex-core detector was removed from one of the nozzle boxes last outage and read 40,000 mr/hr. The surface dose rate near the welds would be very close to these detectors. Therefore, the implementation of this Code Case reduces the radiation exposure by several man-rem while providing an acceptable level of quality and safety.

Background

The qualification documentation and the procedure for the qualification of the Ultrasonic Examination Technique used at the Fort Calhoun Station during the 2003 refueling outage to perform the surface examinations of the reactor vessel B-F welds are included in Attachment B and Attachment C respectively.

The ultrasonic examinations were performed during the fall 2003 refueling outage and no surface indications were identified.

Attachment B

Affidivit from Framatome ANP, Inc Supporting Proprietary Nature of Referenced Documents

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is Gayle F. Elliott. I am Manager, Product Licensing, for Framatome ANP ("FANP"), and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by FANP to determine whether certain FANP information is proprietary. I am familiar with the policies established by FANP to ensure the proper application of these criteria.

3. I am familiar with the FANP reports 54-ISI-189-00 and 54-PQ-189-01 and referred to herein as "Document." Information contained in this Document has been classified by FANP as proprietary in accordance with the policies established by FANP for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by FANP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in the Document be withheld from public disclosure.

6. The following criteria are customarily applied by FANP to determine whether information should be classified as proprietary:

(a) The information reveals details of FANP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for FANP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for FANP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by FANP, would be helpful to competitors to FANP, and would likely cause substantial harm to the competitive position of FANP.

7. In accordance with FANP's policies governing the protection and control of information, proprietary information contained in this Document has been made available, on a limited basis, to others outside FANP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. FANP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

[signature]

SUBSCRIBED before me this 24th
day of October, 2003.

[signature]

Ella F. Carr-Payne
NOTARY PUBLIC, STATE OF VIRGINIA
MY COMMISSION EXPIRES: 8/31/05

ELLA F. CARR-PAYNE
Notary Public
Commonwealth of Virginia
My Commission Exps. Aug. 31, 2005

Results from ID & OD Clad Safe-end Mockup Block Demonstration for Fort Calhoun

54-PQ-189-01

Prepared by: [signature] Date: 09/24/03
M. W. Key, UT Level III

Approved by: M. G. Hacker Date:09/24/03
M. G. Hacker, UT Level III

Objectives:
The objective of this demonstration was to document the detection of opposite surface cracking through the ID & OD cladding surrounding the safe end. A secondary objective was to document the detection of side drilled holes through the welds.

Background:
Prior to the 2003 RFO RPV 10-year examination, the need to demonstrate Framatome ANP inspection techniques on component configurations unique to Fort Calhoun was required. The safe ends employed by Fort Calhoun are made of forged stainless steel (CCSS) with cladding on both ID and OD surfaces. To facilitate this demonstration, a block with cladding on both ID and OD surfaces was obtained from (see Figure 1). Framatome ANP PDI procedure 54-ISI-821 was used as a template for the opposite surface flaw detection. It was 54-ISI-821 that served as a foundation for the development of 54-ISI-189 that became the specific examination procedure for use at Ft. Calhoun.

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Summary:
The results of the demonstration show that opposite side cracks were detected.

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Demonstration Setup:
Inspection of the demonstration block was performed at EPRI with Framatome ANP X/Y scanner (see Figure 2). The cladding on the ID surface is hand blended to a smooth surface when compared to the OD clad surface roughness (See Figure 1) which is also hand blended but to as lesser extent. The opposite side inspection was performed to the requirements of 54-ISI-821 with the exception of scanning sensitivity (material noise set to 10% FSH), transducer selection, and the acquire range (larger than procedural requirements). Both axial (normal to side drilled holes) and circumferential scans (parallel to side drill holes) were made on each surface.

The demonstration block contains two surface connected thermal fatigue cracks located in the safe end material on the surface representing the OD. The cracks are identified as "G" and "H" and have the following dimensions:

Flaw	Orientation[1]	Length	Ratio	Depth	Depth%	Tilt
G	Circ.	0.500"	2.5:1	0.200"	8%	0°
H	Axial	0.500"	2.5:1	0.200"	8%	0°

[1] Axial defined as normal to the weld.

The following transducers were used to inspect block #:

ID SURFACE (OPPOSITE SIDE FLAWS)					
Manf	Angle	Freq.	Size	Focal Depth	S/N

Results:
The results from flaw detection and sizing are presented in the following tables. The scan direction "X" directs the ultrasonic beam parallel to the welds and thus is sensitive to flaw "G". Likewise, scan direction "Y" directs the beam perpendicular to the welds and is sensitive to flaw "H". In those cases where the flaw was detected, a signal to noise ratio is given in the parenthesis for that specific scan.

DETECTION: OPPOSITE SIDE EXAMINATION RESULTS (SCAN SURFACE: ID)

Angle /Mode	Manf.	Filename	Scan Dir.	Flaw "G"	Flaw "H"	Fig.

DETECTION (cont.): OPPOSITE SIDE EXAMINATION RESULTS (SCAN SURFACE: ID)

Angle /Mode	Manf.	Filename	Scan Dir.	Flaw "G"	Flaw "H"	Fig.

The results indicate that the is capable of detecting flaw "G" while not detecting flaw "H". Conversely, the is capable of detecting flaw "H: while not detecting flaw "G".

Conclusion:

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Deleted: Sigma [... [2]]
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Deleted: Not Possible: Mockup geometry does not permit detection from this direction with this transducer due to the location of hole "E" and the edge of the ID clad. In addition not on clad surface. See Figure 3. [... [5]]
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Deleted: A3231_07.08.55 [... [7]]
Deleted: N/A
Beam Propagation wrong direction for detection [... [8]]
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Length: 0.59"
Depth: 0.167"
Deleted: A3231_07.23.11 [... [9]]
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Deleted: Not Possible: Mockup block width does not permit detection from this direction with this transducer. See Figure 5.
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Deleted: A3231_07.47.57 [... [11]]
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Deleted: Det. (4:1)
Length: 0.79"
Depth: 0.084"
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Deleted: 8
Deleted: Not Possible: Mockup block width does not permit detection from this direction with this transducer. See Figure 6.
Deleted: 45/L [... [13]]
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Deleted: A3231_08.29.04 [... [15]]
Deleted: 45°S... 45°L [... [16]]
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Based on the analysis of the data collected from the demonstration block, opposite surface flaws of the size and type found in the block can be detected using the search units specified in this report.

Recommendation:

It is recommended that the transducer be used to examine the OD surface of the Pipe. See Appendix A for further information

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Figure 1: Side View of CRC DM Piping Block

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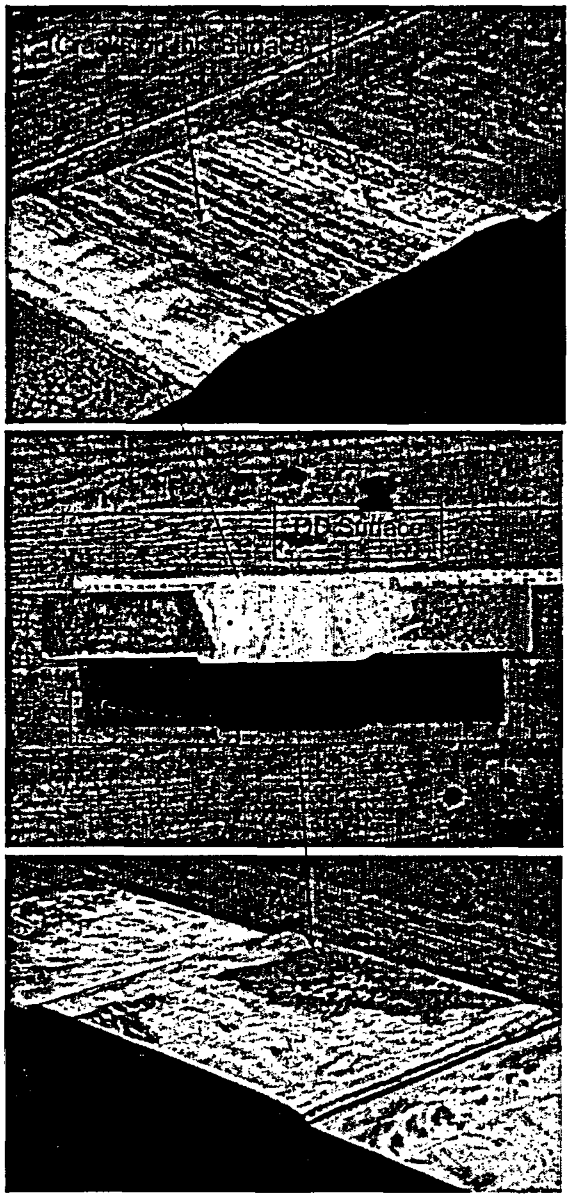

Figure 2: Framatome ANP X/Y Scanner Setup

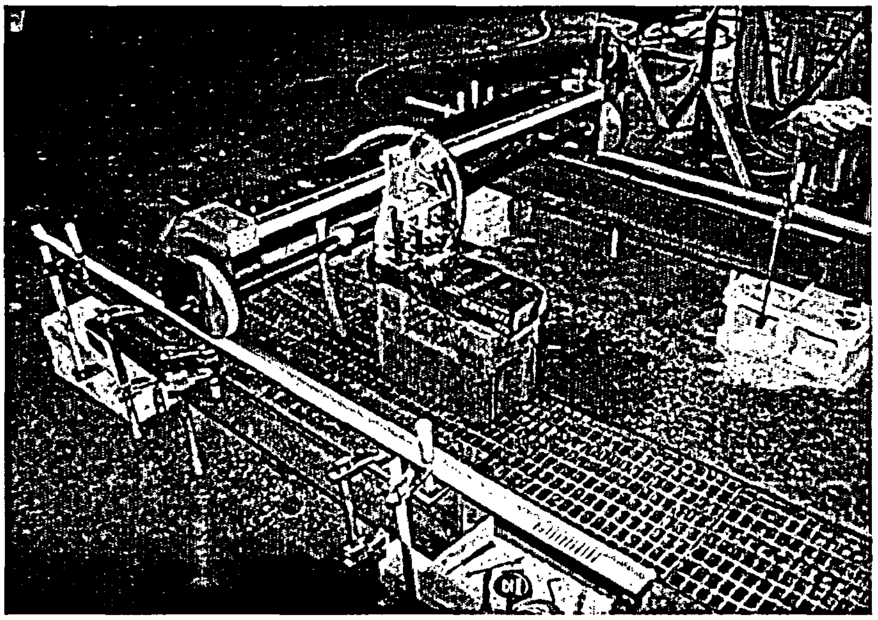

Figure 3: Opposite Side Scan, Flaw "G" (Beam: X+)

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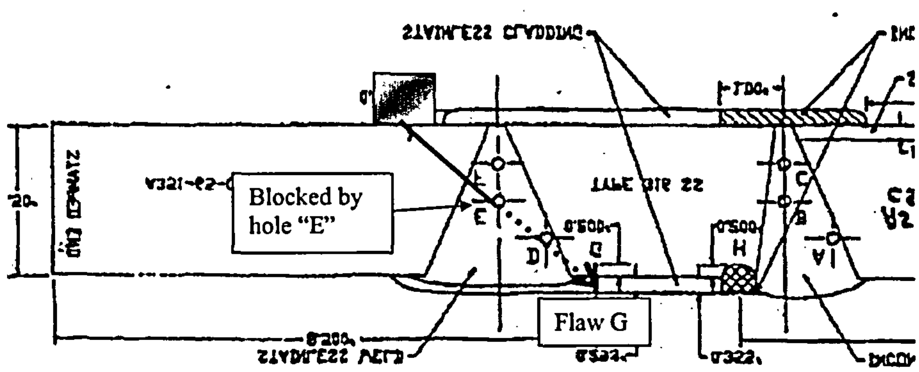

Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

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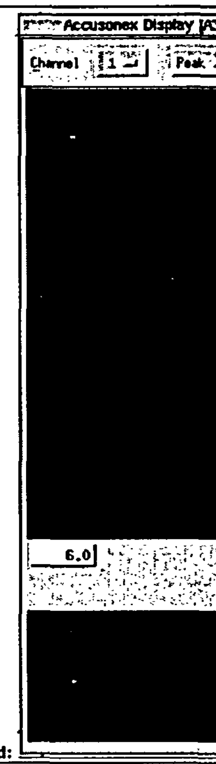

Figure 4: Opposite Side Scan, Flaw "G" (Beam: X-)

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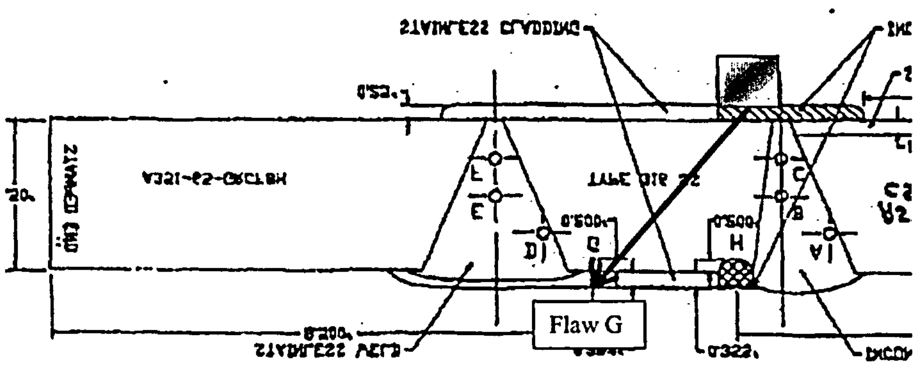

Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

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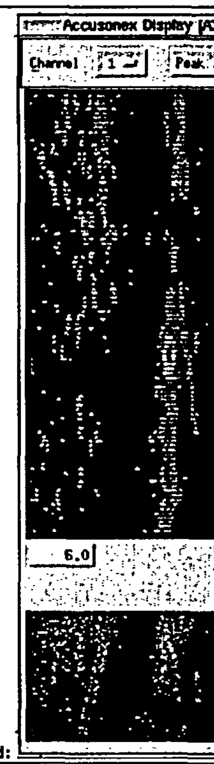

Figure 5: Opposite Side Scan, Flaw "H" (Beam: Y+)

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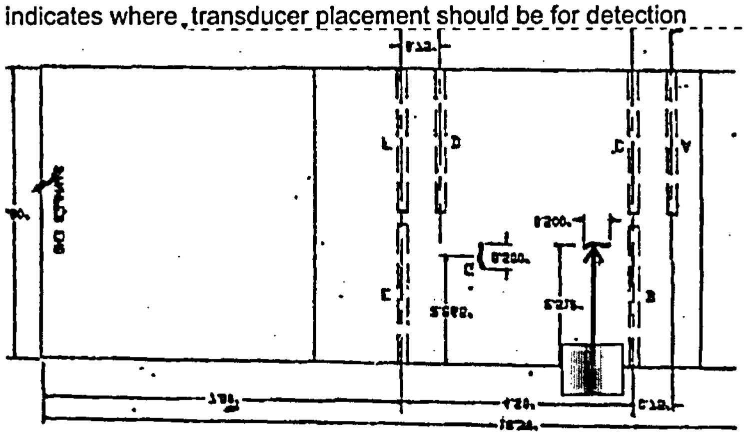
Arrow length indicates where, transducer placement should be for detection



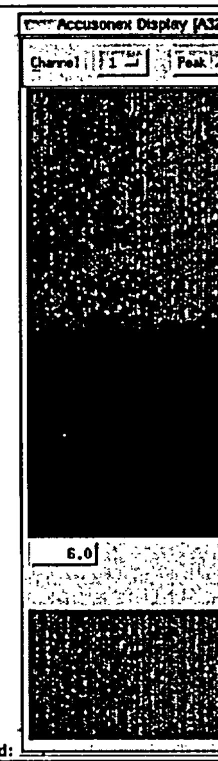


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Figure 6: Opposite Side Scan Flaw "H" (Beam: Y-)

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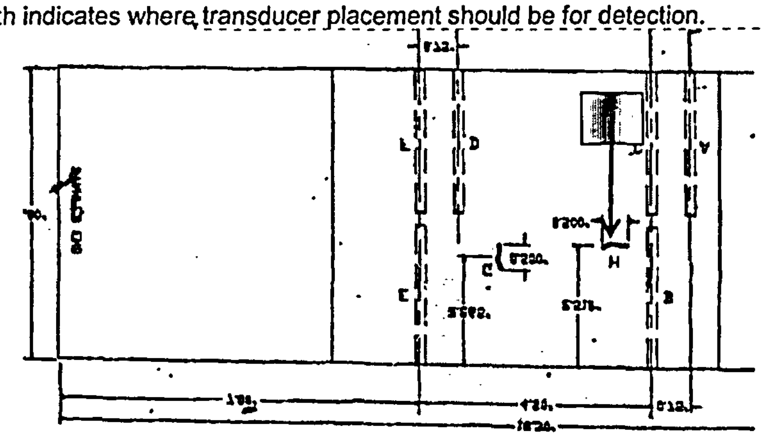
Arrow length indicates where transducer placement should be for detection.



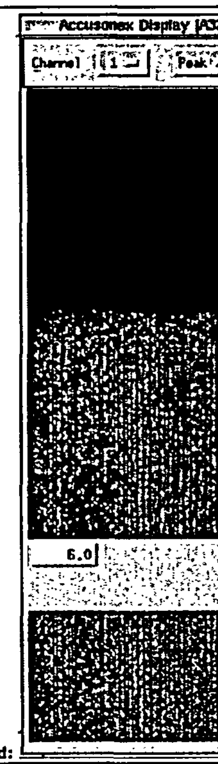


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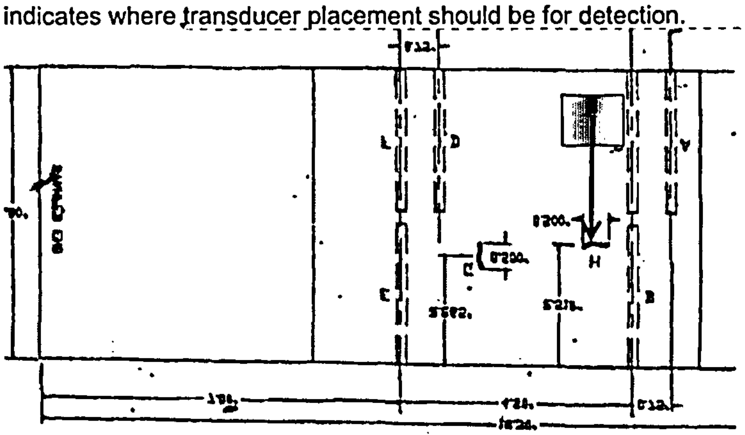
Figure 7: Opposite Side Scan, Flaw "H" (Beam: Y-)

Arrow length indicates where transducer placement should be for detection.



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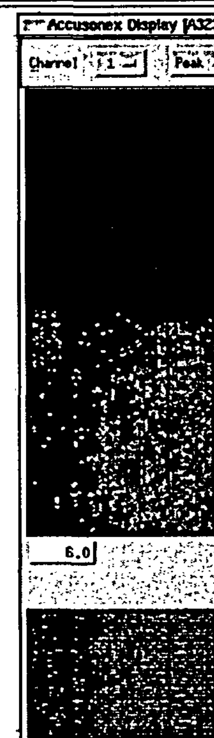

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Figure 8: Opposite Side Scan, Flaw "H" (Beam:Y+)

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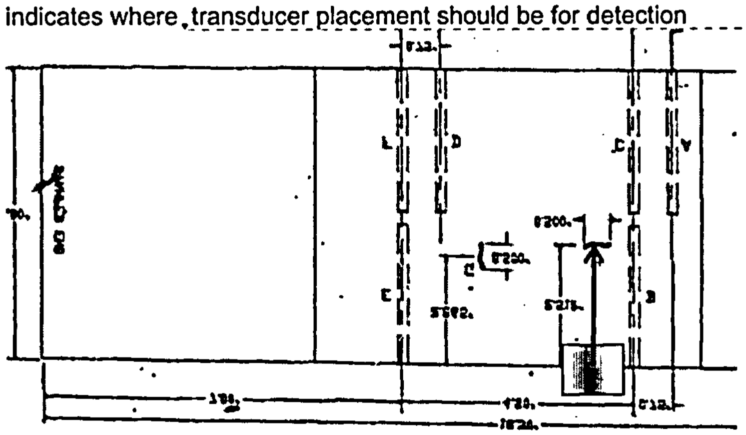
Arrow length indicates where, transducer placement should be for detection



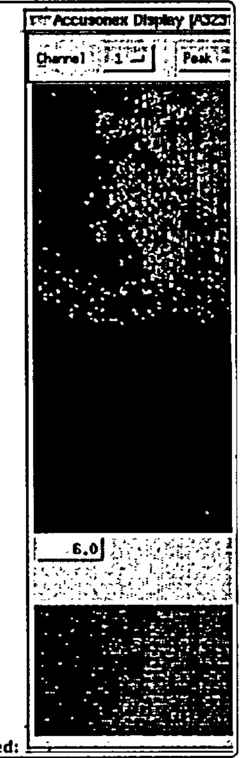


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Figure 9: Opposite Side Scan, Flaw "G" (Beam: X+)

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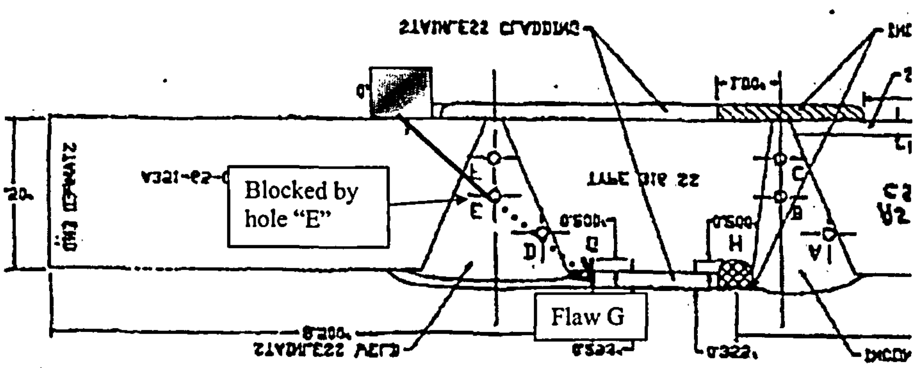

Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

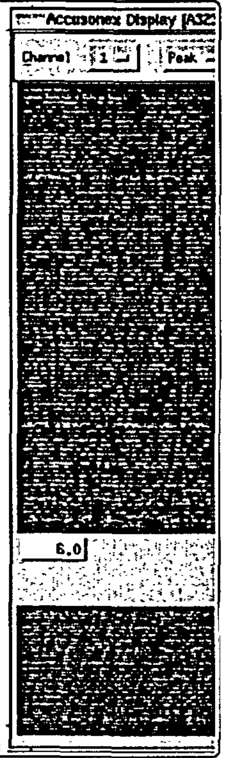

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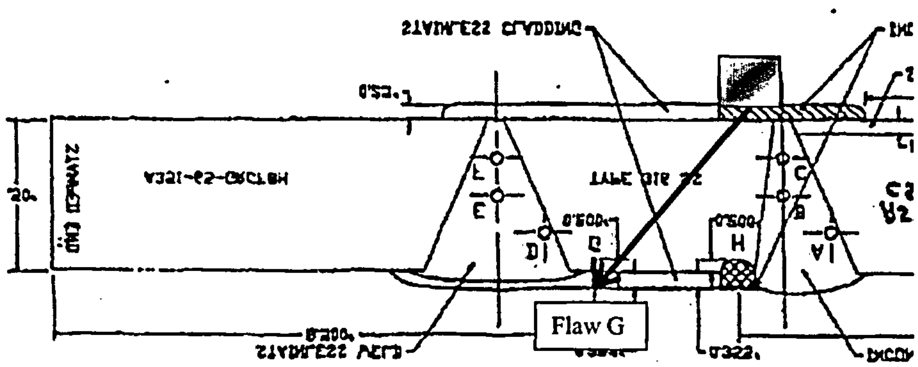
Figure 10: Opposite Side Scan Flaw "G" (Beam: X-)



Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

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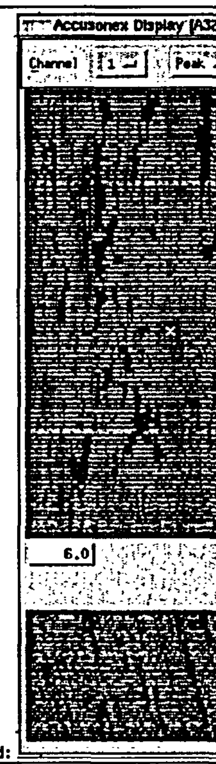

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APPENDIX A: TRANSDUCER RESULTS

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Background:
Previous experience using for flaw detection through austenitic welds indicate that ultrasound penetration can be limited. In those cases, are frequently used to provide penetration through the welds.

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Summary:
The results of the demonstration show that all side drilled holes were detected.

Demonstration Setup:
Same demonstration setup as used during the crack detection.

The following transducers were used for detection of side drilled holes:

ID SURFACE (OPPOSITE SIDE FLAWS)					
Manf	Angle	Freq.	Size	Focal Depth	Model

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The did not show consistent or repeatable detection of the side drilled holes and therefore will not be included in this work scope.

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Results:
The side drilled hole detection results are presented in the following table:

Angle /Mode	Manf.	Filename	Scan Dir.	Side Drill Hole A	B	C	D	E	F	Fig.

[†]Detection not possible due to component configuration.

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Deleted: DET ... [24]
Deleted: Sigma
Deleted: A3231_10.15.46 ... [25]
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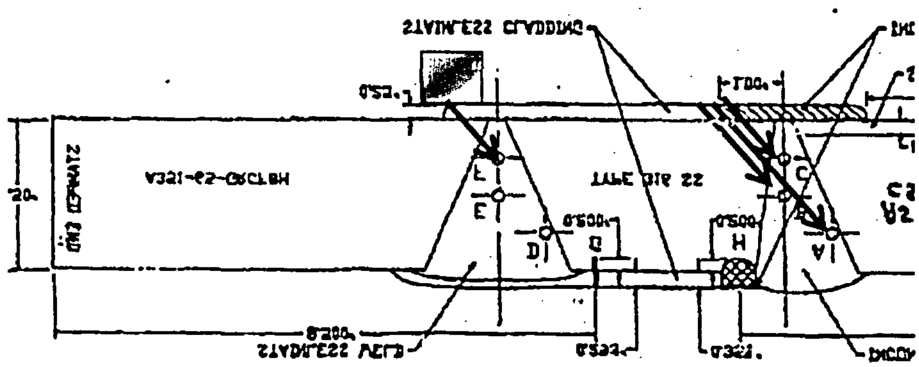
Recommendation:
It is recommended that the transducers be used in conjunction with the transducer to assure adequate penetration through the welds that make up the component.

Figure 11: "ID" Side Scan with (Beam: X+) Holes "A", "B", "C" and "F"



Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrows indicate beam propagation.

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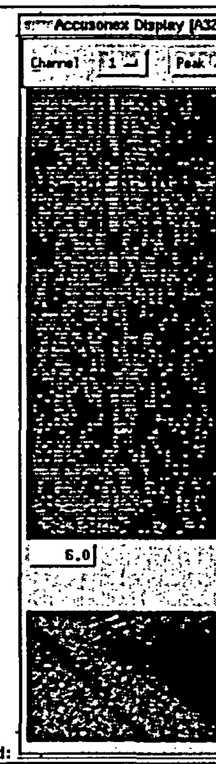

Figure 12: "ID" Side Scan with (Beam: X-) Holes "A", "C", "D", "E" and "F"

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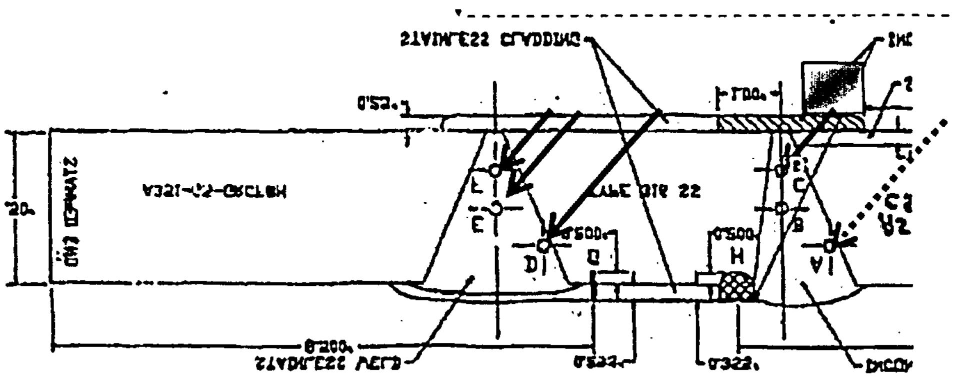

Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Hole "A" detected off clad surface. Arrows indicate beam propagation.

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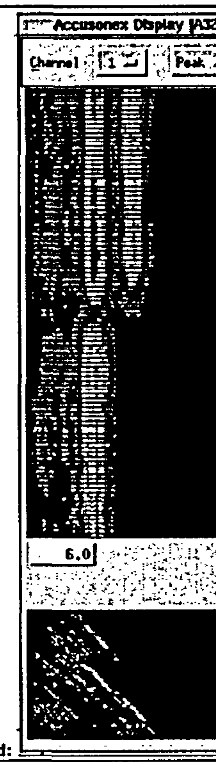

Figure 13: "OD" Side Scan with (Beam: X+) Holes "A", "B", "C" and "D"

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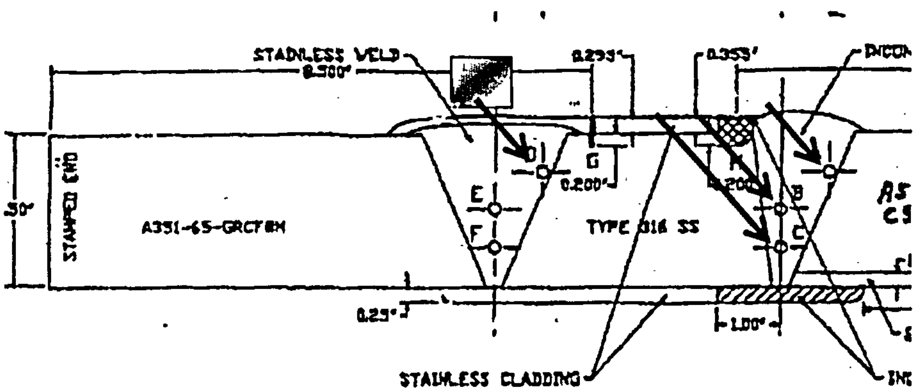

Arrows indicate beam propagation.

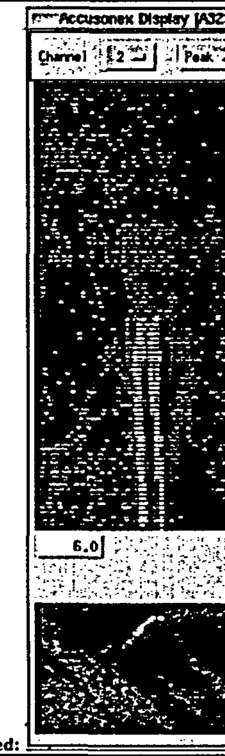

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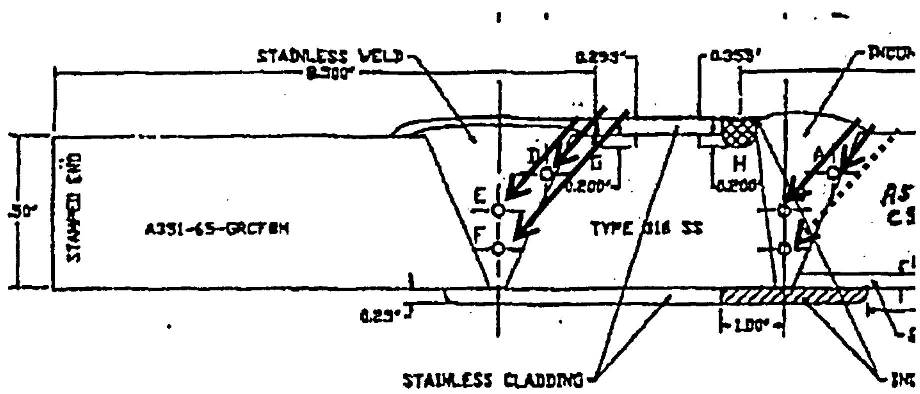
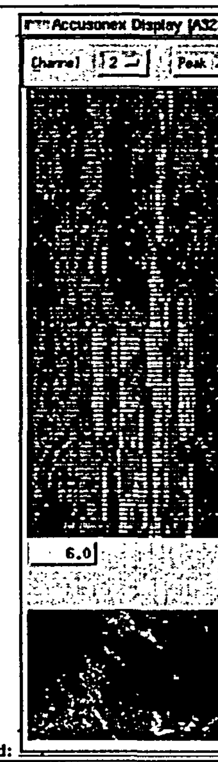
Figure 14: "OD" Side Scan with (Beam: X-) Holes "A", "B", "C", "D" "E", AND "F"

Deleted: 45°L (21FG – 2 Mhz)



Hole "C" detected off clad surface. Arrows indicate beam propagation.



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Sigma

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45°L

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1Mhz

Page 3: [1] Deleted	default	11/18/2003 5:55 PM

2(1.0" x 0.6")

Page 3: [1] Deleted	default	11/18/2003 5:55 PM

2.25"

Page 3: [1] Deleted	default	11/18/2003 5:55 PM

21GW

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Sigma

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45°L

Page 3: [2] Deleted	default	11/18/2003 5:55 PM

2Mhz

Page 3: [2] Deleted	default	11/18/2003 5:55 PM

2(0.7" x 0.4")

Page 3: [2] Deleted	default	11/18/2003 5:55 PM

1.5"

Page 3: [2] Deleted	default	11/18/2003 5:55 PM

21FG

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RTD

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45°S EL

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2Mhz

Page 3: [3] Deleted	default	11/18/2003 5:55 PM

Ell(16 x 10)

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N/A

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95-420

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A3231_06.51.35

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X+

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Not Possible: Mockup geometry does not permit detection from this direction with this transducer due to the location of hole "E" and the edge of the ID clad. In addition not on clad surface. See Figure 3.

Page 3: [5] Deleted default 11/18/2003 5:55 PM

N/A

Beam Propagation wrong direction for detection

Page 3: [6] Deleted default 11/18/2003 5:55 PM

45/S

Page 3: [6] Deleted default 11/18/2003 5:55 PM

RTD

Page 3: [7] Deleted default 11/18/2003 5:55 PM

A3231_07.08.55

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X-

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N/A

Beam Propagation wrong direction for detection

Page 3: [8] Deleted default 11/18/2003 5:55 PM

4

Page 3: [9] Deleted default 11/18/2003 5:55 PM

A3231_07.23.11

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Y+

Page 3: [9] Deleted default 11/18/2003 5:55 PM

N/A

Beam Propagation wrong direction for detection

Page 3: [10] Deleted default 11/18/2003 5:55 PM

A3231_07.31.40

Page 3: [10] Deleted default 11/18/2003 5:55 PM

Y-

Page 3: [10] Deleted default 11/18/2003 5:55 PM

N/A

Beam Propagation wrong direction for detection

Page 3: [10] Deleted default 11/18/2003 5:55 PM

NDD

Page 3: [10] Deleted default 11/18/2003 5:55 PM

6

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A3231_07.47.57

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Y-

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N/A

Beam Propagation wrong direction for detection

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A3231_07.59.15

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Y+

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N/A

Beam Propagation wrong direction for detection

Page 3: [13] Deleted default 11/18/2003 5:55 PM

45/L

Page 3: [13] Deleted default 11/18/2003 5:55 PM

Sigma

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A3231_08.10.47

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X+

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Not Possible: Mockup geometry does not permit detection from this direction with this transducer due to the location of hole "E" and the edge of the ID clad. In addition not on clad surface. See Figure 9.

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N/A

Beam Propagation wrong direction for detection

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9

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A3231_08.29.04

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X-

Page 3: [15] Deleted default 11/18/2003 5:55 PM

NDD

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N/A

Beam Propagation wrong direction for detection

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10

Page 3: [16] Deleted default 11/18/2003 6:12 PM

45°S

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45°L

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Page 15: [18] Deleted default 11/18/2003 6:04 PM

shear waves

Page 15: [18] Deleted default 11/18/2003 6:05 PM

longitudinal waves

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greater

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Sigma

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45°L

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1Mhz

Page 15: [19] Deleted default 11/18/2003 6:00 PM

2(1.0" x 0.6")

Page 15: [19] Deleted default 11/18/2003 6:00 PM

2.25"

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21GW

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Sigma

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45°L

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2 Mhz

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2(0.7" x 0.4")

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1.5"

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21FG

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Page 15: [21] Deleted	default	11/18/2003 6:00 PM
	X+	

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	NP†	

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	X+	

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NP†

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X-

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DET

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DET

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14

Page 15: [27] Deleted	default	11/18/2003 6:07 PM

45°L

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45°S wave

FRAMATOME ANP

FRAMATOME ANP
NONDESTRUCTIVE EXAMINATION PROCEDURE

ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws

Procedure Number
54-ISI-189-00

Issue Date: September 16, 2003

Prepared by: ______________________ 9/16/2003
M. W. Key Level III

Approved by: ______________________ 9/16/2003
M. G. Hacker Level III

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ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws	Procedure 54-ISI-189-00 54-PQ-189-01

Record Of Revision

Rev.	Page #	Para. #	Description of Change
00	All	All	Initial Issue

ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws	Procedure 54-ISI-189-00 54-PQ-189-01

TABLE OF CONTENTS

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1. Scope

1.1 This procedure shall govern the automated contact ultrasonic examination for OD initiated flaws in full penetration dissimilar metal piping welds and wrought, austenitic piping welds and adjacent base material by scanning from the ID surface.

1.2 The objective of the examinations performed in accordance with this procedure is to detect and characterize outside surface connected service induced discontinuities within the specified examination area.

1.3 Where accessible, examinations shall be performed from both sides of the weld with the beam directed perpendicular and parallel to the weld.

1.4 This procedure has been demonstrated by scanning the inside surface of shop weld configurations containing clad on both the ID and OD surfaces.

2. Surface Preparation

2.1 This procedure has been demonstrated using as-welded component configurations. However, if ultrasonic coverage of the required examination volume is limited due to surface conditions, the conditions shall be documented and reported to the owner for disposition.

3. Personnel Qualifications

3.1 There are three basic categories of personnel involved in performing this examination. They are calibration personnel, data acquisition personnel, and data analysis personnel described as follows:

3.2 **Calibration Personnel** are responsible for performing the ultrasonic calibrations and calibration checks and shall be qualified to at least Level II or higher in accordance with the Framatome ANP written certification practice. These personnel shall have received special training in the use of the automated data acquisition (ACCUSONEX™) system and are qualified to establish calibrations in accordance with specific procedure requirements. A qualified UT Level II or Level III data analyst must review calibrations or calibration checks.

3.3 **Data Acquisition Personnel** are responsible for operating the data acquisition system do not require training or certification in the ultrasonic method because their activity is limited to operation of equipment only and they do not make decisions concerning system configuration or the ultrasonic data itself. Their activity is limited to operation of the system controls that execute pre-established scan plans. All equipment settings

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considered essential variables can be independently verified with the recorded data by the data analyst.

3.4 **Data Analysis Personnel** are responsible for performing the data analysis functions detailed within this procedure and for assuring that all of the requirements concerning the data acquisition and analysis identified in this procedure have been met. The data analysis personnel shall be qualified to at least a Level II or higher in accordance with the Framatome ANP written certification practice.

4. Equipment

4.1 The remote ultrasonic examination equipment shall consist of an automated data acquisition and analysis system (ACCUSONEX™), an encoded manipulator, the appropriate intermediate cabling, and transducers.

4.2 ACCUSONEX™ Data Acquisition and Imaging System

4.2.1 ACCUSONEX™ consists of an automated data acquisition and an analysis system. The data acquisition system is capable of collecting and digitizing the ultrasonic data, recording time and amplitude of indications which exceed a preset recording threshold and recording the manipulator position coordinates at the time the signal exceeds the threshold. The analysis system is capable of displaying the recorded data in various formats (A-scan, B-scan, C-scan, and D-scan) to aid in analysis of the data. The ACCUSONEX™ data acquisition system consists of the components described in Table B. The ACCUSONEX™ data analysis system consists of the components described in Table C.

Table B – ACCUSONEX™ Data Acquisition System

Item	Component	Model Number
1		
2		
3	ACCUSONEX™ Data Acquisition Software	
4	ACCUSONEX™ Calibration Software	
5	Computer System with Storage Device	

Note: Items 1, 2, 3, and 4 are considered essential variables of the acquisition system. Later versions of the ACCUSONEX software (items 3 and 4) may be

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Deleted: R/D Tech Pulser/Receiver Main Board
Deleted: EQTX100C
Deleted: Pulser Receiver Piggy Boards (Number of boards vary depending upon the number of channels that the system is configured for)
Deleted: EQTX101D
Deleted: R/D Tech Digitizer (CPU)
Deleted: EQTX098C
Deleted: R/D Tech remote pulser/receiver
Deleted: CU
Deleted: R/D Tech Pulser/Receiver Main Board
Deleted: EQUX097D
Deleted: Pulser Receiver Piggy Boards (Number of boards vary depending upon the number of channels that the system is configured for)
Deleted: EQUX093F
Deleted: Version 6.4
Deleted: Version 6.4
Deleted: Standard PC
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used if the revision does not affect the derivation of amplitude and/or time values of the recorded data.

Table C – ACCUSONEX™ Data Analysis System		
Item	Component	Model Number
1	Computer System	
2	Storage Device	
3	Color Printer	
4	ACCUSONEX™ Data Analysis Software	

Note: Item 4 is considered an essential variable of the analysis system. Later version of the analysis software may be use if the revision does not affect the imaging displays, the derivation of amplitude, and/or the time values of the recorded data.

4.3 Manipulator

4.3.1 An encoded manipulator shall be used. The manipulator shall be capable of providing positional data from a given reference mark, have the ability to control transducer positioning relative to component axis, and provide adequate force to keep the transducer coupled to the scan surface. The manipulator shall be capable of performing scanning and indexing requirements in accordance with this procedure.

4.4 Transducer Cables

4.4.1 The interconnecting cable consists of RG-174 (co-axial) cables.

4.5 Transducers

4.5.1 Transducers listed in Table D are qualified for use with this procedure. Transducers selection shall be based upon the intended application from the following table.

Table D Transducer Selection						
Mfg. /Model	Nominal Angle/Mode	Nominal Frequency	Style	Focal Depth	Element Size/Shape	Application

4.6 Water shall be used as the couplant to perform the calibrations and the examinations.

Deleted: Standard PC
Deleted: Hard Disk
Deleted: Generic
Deleted: Version 3.12
Deleted: The cables interconnecting the μTomo and the remote pulser consist of up to 171 feet of length with a maximum of four intermediate connectors. The cables interconnecting the remote pulser and the transducers consist of up to 70 feet of length with four intermediate connectors. This configuration has been successfully demonstrated. Reduced cable lengths and intermediate connectors are acceptable for use without further demonstrations. Figure 1 represents a typical qualified cable configuration.¶
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Deleted: Axial & Circ Flaw Detection & Sizing
Deleted: RTD / 03-887
Deleted: 45° S-wave
Deleted: 2.0 MHz
Deleted: Single
Deleted: Flat
Deleted: 1.0" x 0.60" ¶ Rectangular
Deleted: Axial & Circ Flaw Detection & Sizing
Deleted: Sigma / 21GW
Deleted: 45° L-wave
Deleted: 1.0 MHz
Deleted: Dual
Deleted: 2.25"
Deleted: 0.7" x 0.40" ¶ Rectangular
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4.7 Reference Blocks

4.7.1 Transducer exit point verification shall be performed using a stainless steel IIW or Rompus block.

4.7.2 Verification of transducer refracted angle, establishing a linear time base, and establishing a reference level for subsequent examinations shall be performed using a stainless steel Side Drilled Hole calibration block similar to the design shown in Figure 2.

4.7.3 Calibration confirmation checks shall be performed on radius blocks capable of producing repeatable signal responses within the calibrated time base.

5. Areas of Interest

5.1 The specified examination volume consists of the weld and 1/2" of base material on both sides of the weld for a depth of ½" as illustrated in Figure 3.

5.2 Limitations to the examination volume described in Figure 3 shall be documented in the examination report.

6. Scan Plan

6.1 Prior to the examination, scan plans shall be developed to ensure the required examination area is scanned with the proper scanning parameters.

6.2 The component geometry shall be reviewed to determine coverage and scan distances. As a minimum the Scan Plan shall identify the scan coordinates that bound the area to be scanned and the transducer head layout with the corresponding transducer offset for each transducer.

6.3 The scan plan shall be reviewed by a data analysis qualified in accordance with paragraph 3.4 to ensure that the requirements of this procedure have been met. No adjustments may be made to the scan parameters after the scan plans have been established without the concurrence of a qualified data analyst.

6.4 Scans will be designated by a Scan Identification Number (SIN) and Subscan Identification to allow the analyst to determine the area examined. The scan identification number and subscan identification shall be identified on the scan plans.

6.5 Scanning shall be performed in a raster pattern in both the axial and circumferential directions. A typical transducer head arrangement used for the examination is shown in Figure 4.

6.6 The following parameters listed in Table E shall be used to establish the scan plan database.

Table E
UT System Parameters

System Parameter	Transducer			Comments
RF				
Threshold (RG)				This is the minimum amplitude that a peak must have to be recorded at *RUN* gain.
Gain Adjust				
Coincidence				This value establishes the number of sequential waveforms that will be compared point by point before feature extraction algorithms are applied.
Rect. Mode				
Threshold (CG)				This is the minimum gain normalized amplitude that a peak must have to be to be recorded.
Delay				This feature permits the insertion of a delay between subsequent pulses if it is determined that the pulse repetition rate is too high. The value is measured in ms. Normally, a value of 0 is used unless evidence of wrap-around is noted in the data. If wrap-around is noted, increase the delay value in .1 ms increments until the signal disappears.
PR Mode				
Pulse Width				
Pulser Source				
Pulser Voltage				The pulser voltage for the surface profile scan may be ensure that the surface response is not saturated.
Gain Boost				
Scan Speed				The systems ability to keep up with recording UT data is a function of several variables and can be controlled by reducing the scan speed. The data analyst can determine during the analysis of the data file if the scan speed was to fast for the system to record the data of interest that are indicated as intermittent areas of no data along the scan line that is not contributed to coupling effects. If the analyst determines the data is unacceptable due to an excessive scan speed a rescan shall be performed at a slower scan speed.
Index Increment				
Sync. Interval				This is the interval at which data is collected along the scan line. The pulse repetition rate is a function of the speed at which the ACCUSONEX™ data acquisition system can be configured to take multi-channel data during automatic operation. The pulse repetition rate is set by the delay and length of the acquire window and the processing time for each A-scan. The pulse repetition rate is not available to the operator as an adjustable control on the system. For the circumferential directed probes, the sync. Interval shall be converted to degrees based on the largest diameter being scanned.
Active Channel				Select the channels that are to be active during the scan.
Display Channel				Activates the channel to be displayed during acquisition.

Deleted: 45°S
Deleted: 45°L
Deleted: 45° L
Deleted: No
Deleted: 5%
Deleted: Dual
Deleted: Dual
Deleted: Dual
Deleted: 1¶
Deleted: ¶ FW
Deleted: ¶ 0%
Deleted: 0¶
Deleted: Single
Deleted: Dual
Deleted: Dual
Deleted: 250
Deleted: 250
Deleted: 500
Deleted: Use 500 for the 1 mHz transducer
Deleted: External
Deleted: adjusted lower to
Deleted: 300
Deleted: None
Deleted: Maximum Speed 6" / sec.
Deleted: 0.15"
Deleted: ¶ 0.05"
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7. System Calibration

7.1 The amplifier vertical and amplitude control linearity shall be verified before and after examining all welds required to be examined. Linearity shall be verified using the digitized waveform provided by the data acquisition system.

7.1.1 Vertical Linearity

7.1.1.1 The ability of the amplifier to provide a linear output for 100 percent of the vertical range shall be verified by the following steps:

7.1.1.1.1 Position a search unit so that echoes can be observed from any two reflectors in a material.

7.1.1.1.2 Adjust the search unit position to give a 2-to-1 ratio of the amplitudes between the two echoes with the larger set at 100% full screen height (FSH) and the smaller at 50% FSH.

7.1.1.1.3 Without moving the search unit, reduce the gain in 2 dB increments to decrease the larger echo to at least 20% FSH and record the amplitude of the smaller echo on the Instrument Control Linearity Sheet.

7.1.1.1.4 The amplitude of the smaller reading must be 50% of the larger reading within ±5% FSH. The settings and readings must be estimated to the nearest 1% of FSH.

7.1.2 Amplitude Control Linearity

7.1.2.1 The linearity of the amplitude controls of the ultrasonic instrumentation shall be verified using the steps outlined below.

7.1.2.1.1 Position a search unit so that an echo can be observed from a reflector in a material.

7.1.2.1.2 With the increases and decreases in the stepped gain control shown in the following table, the indication must fall within the specified limits below:

Indication set at % of FSH	dB Control change	Indication limits, % of full screen
80%	-6 dB	32 to 48%
80%	-12dB	16 to 24%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%

7.2 A static or dynamic calibration shall be established for each transducer utilizing the applicable reference block using the peak amplitude of the reflectors to develop the appropriate sweep range and reference level.

7.3 Transducer exit points shall be measured and documented prior to use using either a rompus or IIW block meeting the requirements of paragraph 4.7.1. The refracted angle shall be checked and documented using a side drilled hole that produces the highest amplitude response in order to obtain an accurate and repeatable measurement.

7.4 Prior to calibration the following system parameters that effect the calibrations shall be set for each applicable setup and channel in accordance with Table F.

Table F
UT System Parameters

System Parameter	Transducer			Comments
XDCR Freq. (Filter)				
TR Freq. (Digitization Rate)				
Rect (Rectification Mode)				
Coincidence Mode				This value establishes the number of sequential waveforms that will be compared point by point before feature extraction algorithms are applied

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Deleted: 1 MHz
Deleted: 25 MHz
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Deleted: 12.5 MHz
Deleted: FW
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7.5 Calibrations may be performed using different cables between the acquisition system and the transducer as compared to the configuration used for actual scanning. When separate cables are used for the calibrations they shall consist of the same cable type, lengths (± 6 feet), and number of intermediate connectors as those used for the examination. When performing the calibrations with different cables then those used for the examination, a comparison of signal responses (time and amplitude) between the calibration and examination cables is required for the complete system (cable, intermediate connectors,, and transducer) for each applicable channel. When required, the cable comparison shall be performed in accordance with the following paragraphs.

Deleted: remote pulser, μtomo

7.5.1 Upon completion of the system calibrations, a baseline response shall be documented for the complete system (cable, intermediate connectors, remote pulser, µtomo, and transducer) for each applicable channel. This is performed using a rompus block meeting the requirements of paragraph 4.7.1.

7.5.2 The response from the radius of the rompus block shall be maximized and recorded for comparison to the examination cable. The time and amplitude shall be documented by printing the A-scan image of the response that shows the gain level, signal amplitude, and depth/µseconds of the reflector.

7.5.3 When the examination system is configured with the cable configuration to be used for the examination, the response from the rompus block radius shall be captured again with the examination cables in accordance with paragraph 7.5.2.

7.5.4 The response shall be compared to determine if any compensation for amplitude or time is required prior to performing the examination.

7.5.4.1 Any variation in amplitude greater than dB shall be compensated for by adjusting the calibration gain level by the amount determined from the comparison for each channel requiring adjustment.

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7.5.4.2 Any variation in time greater than shall be compensated for by adjusting the position of each calibration point by the amount determined from the comparison for each channel requiring adjustment.

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7.6 Time Base Calibration

7.6.1.1 A calibrated time base shall be established for the angle beam transducers using the nominal reflectors from a reference block that meets the material requirements of paragraph 4.7.2. Mark their position and amplitude using the location markers in the calibration window, then adjust the markers to % FSH and save the setup.

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7.7 Enter the appropriate calibration information (Transducer ID, manufacture, calibration block, etc.) in the calibration header.

7.8 Calibration Gain (Cal Gain)

7.8.1 The primary reference sensitivity (Cal Gain) for the angle beam transducers will be established using the peak amplitude from a hole reflector located block for each transducer. Adjust the response to % (+/- 5%) FSH. This shall be the level to be used for examinations.

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Deleted: primary reference

Deleted: comparison for future

Deleted: so that the material noise averages 10% FSH

7.9 Scanning sensitivity (run gain) for each inspection angle shall be set.

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7.10 The acquire window (relative to the gate start position) establishes the range of data to be recorded by the data acquisition system.

7.10.1 The acquire window shall start at a depth of and extend to at least" beyond the thickness of the material. The component shall be considered when establishing the required range.

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7.11 Calibration Confirmation

7.11.1 Upon completion of the initial system calibrations, the calibration confirmation baseline shall be established. This is performed by copying the initial calibration setup to a setup designated to be used for the calibration checks.

7.11.2 Perform a scan of the reference blocks meeting the requirements of paragraph 4.7.3 with each transducer using the designated calibration setup. The same block shall be used for all subsequent measurements. However, the same block need not be used for each transducer.

7.11.3 In the analysis mode, use the beam select feature to capture two reflectors that will be used to measure amplitude and depth responses. Record these values for reference. This baseline response will be used to evaluate future performance of the complete system during the confirmation checks.

7.11.4 Perform all subsequent calibration checks in the same manner and record the amplitude and depth responses.

7.11.5 Intermediate calibration checks shall be performed at approximately, when cable changes are made from the initially calibrated set, or at any point where the analyst suspects malfunction of the system.

Deleted: 12-hour intervals

7.11.6 A final calibration check shall be performed on the reference block upon completion of examinations.

7.11.7 Signal response during calibration checks or the final calibration must be within " of the initial sweep reading and dB of the initial amplitude response. If any of the reference points fail to meet these requirements, the following steps shall be completed:

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7.11.7.1 All examinations since the last successful calibration shall be evaluated by a qualified analyst to determine the effects of the calibration check results. Rescans shall be issued for any data that is evaluated as deficient.

7.11.7.2 Correct the calibration for future data collection.

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8. Scanning Requirements

8.1 The temperature of the component to be examined shall not exceed 120° F.

8.2 The scanner shall be calibrated to provide accurate positional information in relationship to the component. This will be accomplished by using the applicable operating instruction (OI) for the scanner being used for the examination.

8.3 The system operator shall select the appropriate scan plan to be executed from the previously entered database.

9. Data Analysis

9.1 Refer to Figure 5 during data analysis for a flow chart of the analysis process

9.2 Weld fabrication and examination data histories, if available, shall be reviewed prior to analysis of the ultrasonic examination data.

9.3 Following the completion of scanning, the ultrasonic data shall be reviewed to assure that the data quality (contact, signal to noise, coupling, etc.) is adequate to properly perform an effective evaluation of the examination data. The data shall also be reviewed to verify that the scanning parameters specified in Sections 6 and 7 were utilized and sufficient. If any of the scan parameters require adjustment, the scan plan shall be revised and rescans performed as necessary. All subsequent scanning shall be made using the revised parameters.

9.4 The analyst shall update and apply the geometry file by inputting the beam angle, beam direction, transducer offsets, and component geometry as applicable, (refer to the scan plan) for each scan to assure that the proper location of indications are reported.

9.4.1 Curvature correction shall be applied to adjust the data to the proper depth and circumferential position when using flat calibration blocks.

9.4.2 The transducer beam orientation is used to set the transducer beam direction with respect to the index coordinates for the specific channel. The range of this parameter is 0 to 360 degrees. The +X orientation is 0 degrees and means that the transducer beam direction is in the positive index direction. Likewise, the -X orientation is 180 degrees and is the negative index direction. The analyst can verify that the correct beam direction orientation has been entered by verifying that the proper target motion is display on the screen based on the scan plan information.

9.5 The recorded data shall be analyzed to the extent that the analyst can determine the classification and location of the indications that meet the data recording criteria.

Indications are defined as coherent patterns of signals observed in the B, C, or D-scan images that exhibit target motion in the beam direction. The following steps should be followed in the initial evaluation process of the ultrasonic data to aid determining the origin of the recorded reflectors.

9.5.1 Recall the data for the channel being analyzed. Using the "expand" feature, display the weld volume from a point at least" before the component OD surface to ~ past the OD surface.

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9.5.2 Adjust the color palette range to provide resolution of the various reflectors throughout the scan. Several palette ranges should be evaluated in order to provide optimum image contrast. Too small of a color range may mask flaw indications with the background noise of the component, while too large of a palette range may not properly display low amplitude indications.

9.5.3 Investigate areas of suspect indications in accordance with paragraphs 9.7 and 9.8. At this point the data that projects into the examination volume should be investigated to view the full target motion of the suspected surface connected flaws. For weld configurations that produce geometric responses due to the inside surface the data shall be evaluated with beam angle correction applied and removed to properly evaluate potential flaw indications that may be obscured by the geometric responses. This allows the analyst to identify indications that have target motion, which may have been obscured in the angle corrected views.

9.6 Indications shall be classified as either geometric or non-geometric (flaw indications). The following paragraphs provide some general guidelines when evaluating examination data with suspected geometric indications.

9.7 Geometric indications are likely to be detected from weld counterbores and weld roots when the beam is directed toward the reflector. This type of indication will normally exhibit a fairly continuous pattern in the D-scan and C-scan images and may be localized in areas or extend a full 360° around the weld. Geometric indications usually exhibit consistent target motion across the length of the indication. For the examinations being performed in accordance with this procedure from the inside surface, geometric indications are usually detected for shop weld configurations from weld root or counterbore conditions. Care should be taken when analyzing data near geometric indications as they may obscure flaw signals.

9.8 Indications that cannot be dispositioned as geometric indications and meet the applicable criteria specified below shall be classified as flaw indications.

9.8.1 Flaw indications usually exhibit themselves as localized areas and peak amplitudes greater than.

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Deleted: background noise levels

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9.8.2 The intent of this procedure is to detect outside surface connected cracks, however the techniques utilized may also detect other types of flaws which have length and depth (lack of fusion, slag) that have to be evaluated by the analyst.

9.8.3 Cracks are surface connected and may appear as isolated indications or multiple related indications within the examination region. When a flaw indication is embedded in a high amplitude surface geometric response the target motion of the flaw response will normally extend through the geometric response.

9.8.3.1 The position of the flaw in relationship to the transducer position, geometric configuration restrictions, flaw orientation (tilt and skew) and position (side of the weld) will affect the flaw response, i.e. a surface flaw may not provide target motion to the surface if the geometry restricts transducer contact over the flaw or the flaw orientation is not favorable to the side of the weld where the transducer is positioned, etc. Questionable indications shall be evaluated from both sides of the weld to ensure proper interpretation of the data.

9.8.4 Non-geometric indications that connect to the outside surface shall be considered planar type flaws. Indications that produce images, which display target motion that extends to or beyond the outside surface, (when viewing the B and D scan displays), shall be considered surface connected indications.

10. Data Recording

10.1 The reflector position, depth, and amplitude at the point of maximum amplitude shall be documented for geometrical or fabrication type indications 50% or greater than the primary reference level. These shall be identified as geometric or fabrication indications on the data sheet. These types of indications are recorded for reference only when comparing past and future examination results.

10.2 Surface connected flaw indications shall be reported regardless of amplitude. Data from other scan directions and/or transducers should be used to confirm the presence of flaw indications where possible.

10.3 The location, amplitude, and length shall be documented for each flaw indication as described in the following paragraphs:

10.3.1 The location of the flaw along the pipe axis (for circumferential flaws) or around the circumference (for axial flaws) shall be recorded. The surface position shall be measured at the point where the target motion intersects the outside surface of the component. Where the target motion of a surface connected flaw does not extend to the outside surface due to flaw position relative to the

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geometry, extend the target motion following the same angle until it intersects the outside surface to determine the flaw position.

10.3.2 Record the maximum amplitude of the indication. For many flaw indications the flaw response may be saturated. If the flaw response is saturated, record the maximum measured amplitude and also indicate that the flaw response is saturated.

10.3.3 Length:

10.3.3.1 For determining the flaw end points the B-scan should be expanded to display the outer 1.0" of material to properly provide the surface position of the indication. Length measurements should be taken at the end points along the flaw axis where the flaw image.

10.3.3.2 For length sizing of circumferentially oriented flaws the measurements shall normally be taken from the flaw orientation or surface geometry condition provides a better response.

10.4 Areas of limited examination coverage shall be recorded in the examination report. Limitation of coverage of the examination volume from the inside surface of the component is usually due to surface geometry that does not allow the transducer to be scanned over the surface or maintain contact. These regions can be identified using the B, C, and D-scan images. To determine the amount of limited coverage measure the areas of transducer liftoff on the image. Both the axial and circumferential extents shall be documented for each transducer and beam direction. The surface profile scan may be performed if more detailed evaluation of the surface condition is required to provide a more precise estimate of limited coverage.

11. Rescans/Supplemental Scans

11.1 The analyst may identify additional scans in order to satisfy the requirements of this procedure or to re-perform scans of areas that are considered inadequate.

11.2 Supplemental examinations, performed in addition to the examinations required by procedure, are acceptable to provide additional information to help resolve or confirm results, provided they are not used to overturn results obtained with the qualified techniques or provide additional coverage of limited areas.

11.3 Data analysis personnel shall be responsible for initiating all instruction for Rescans or Supplemental scans.

Deleted: Is obscured by background noise levels using the C-scan with the flaw image expanded to provide adequate resolution of the proper endpoint scan line or the Beam Profile display

Deleted: same side of the weld that the flaw is located on, unless the

Deleted: from the other side of the weld

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12. Reporting

12.1 The results of the examination shall be reported to the customer. All indications shall be individually processed and evaluated by a qualified analyst. Any area where limited or no examination was performed shall be documented and reported to the customer. A copy of the examination data shall be provided to the customer. As a minimum the following information shall be included;

12.1.1 Scan plan

12.1.2 Calibration records

12.1.3 Date and time of calibration, calibration checks, and examination

12.1.4 Names of and certification levels of examination personnel

12.1.5 Examination procedure number and revision

12.1.6 Calibration block identification

12.1.7 ACCUSONEX^{TM} data acquisition system identification number

12.1.8 Transducer frequency, size, angle, mode, and serial number

12.1.9 Cable type, length, and number of intermediate connectors

12.1.10 Calibration reflector amplitude and depth values

12.1.11 Acquisition and analysis software versions

12.1.12 Couplant

12.1.13 Weld identification

12.1.14 Examination surface

12.1.15 Beam orientation in relationship to the pipe

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Figure 1
Typical Qualified Cable Configuration

ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws	Procedure 54-ISI-189-00 54-PQ-189-01

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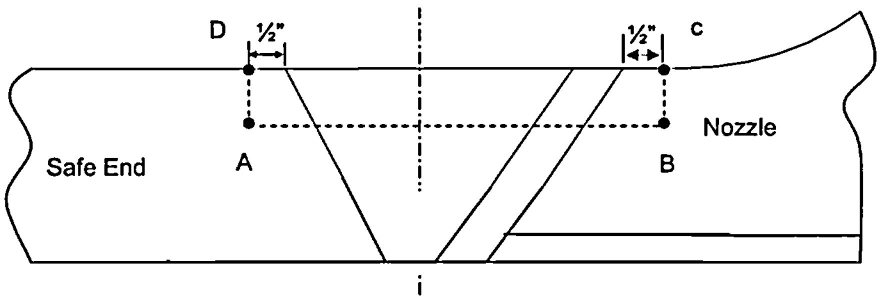
Figure 2 - Typical Calibration Standard



Examination Volume for Dissimilar Metal Welds A-B-C-D

Figure 3 - Examination Volume

Comment: Please check all paragraph references and you may want to include documentation of limited scan areas.

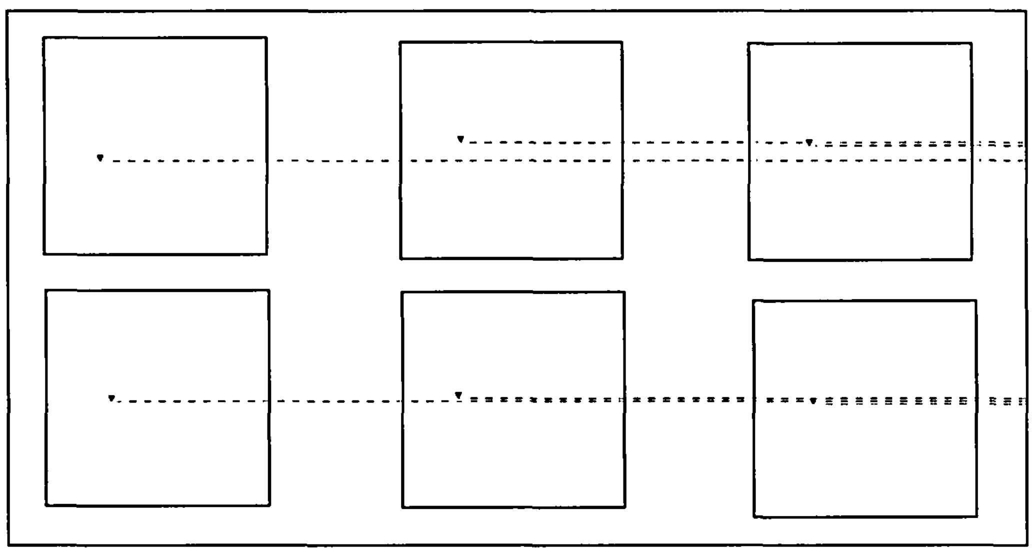


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Figure 4
Typical Transducer Head Arrangement

Figure 5 - Data Analysis Flow Chart

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ATTACHMENT E

Non-Proprietary Version
Of
Framatome Report 54-PQ-189-01

Results from ID & OD Clad Safe-end
Mockup Block Demonstration
for
Fort Calhoun

Results from ID & OD Clad Safe-end Mockup Block Demonstration for Fort Calhoun

54-PQ-189-01

Prepared by: M. W. Key, UT Level III Date: 09/24/03

Approved by: M. G. Hacker, UT Level III Date:09/24/03

Objectives:
The objective of this demonstration was to document the detection of opposite surface cracking through the ID & OD cladding surrounding the safe end. A secondary objective was to document the detection of side drilled holes through the welds.

Background:
Prior to the 2003 RFO RPV 10-year examination, the need to demonstrate Framatome ANP inspection techniques on component configurations unique to Fort Calhoun was required. The safe ends employed by Fort Calhoun are made of forged stainless steel (CCSS) with cladding on both ID and OD surfaces. To facilitate this demonstration, a block with cladding on both ID and OD surfaces was obtained from (see Figure 1). Framatome ANP PDI procedure 54-ISI-821 was used as a template for the opposite surface flaw detection. It was 54-ISI-821 that served as a foundation for the development of 54-ISI-189 that became the specific examination procedure for use at Ft. Calhoun.

Summary:
The results of the demonstration show that opposite side cracks were detected.

Demonstration Setup:
Inspection of the demonstration block was performed at EPRI with Framatome ANP X/Y scanner (see Figure 2). The cladding on the ID surface is hand blended to a smooth surface when compared to the OD clad surface roughness (See Figure 1) which is also hand blended but to as lesser extent. The opposite side inspection was performed to the requirements of 54-ISI-821 with the exception of scanning sensitivity (material noise set to 10% FSH), transducer selection, and the acquire range (larger than procedural requirements). Both axial (normal to side drilled holes) and circumferential scans (parallel to side drill holes) were made on each surface.

The demonstration block contains two surface connected thermal fatigue cracks located in the safe end material on the surface representing the OD. The cracks are identified as "G" and "H" and have the following dimensions:

Flaw	Orientation[1]	Length	Ratio	Depth	Depth%	Tilt
G	Circ.	0.500"	2.5:1	0.200"	8%	0°
H	Axial	0.500"	2.5:1	0.200"	8%	0°

[1] Axial defined as normal to the weld.

The following transducers were used to inspect block #:

ID SURFACE (OPPOSITE SIDE FLAWS)					
Manf	*Angle*	*Freq.*	*Size*	*Focal Depth*	*S/N*

Results:
The results from flaw detection and sizing are presented in the following tables. The scan direction "X" directs the ultrasonic beam parallel to the welds and thus is sensitive to flaw "G". Likewise, scan direction "Y" directs the beam perpendicular to the welds and is sensitive to flaw "H". In those cases where the flaw was detected, a signal to noise ratio is given in the parenthesis for that specific scan.

DETECTION: OPPOSITE SIDE EXAMINATION RESULTS (SCAN SURFACE: ID)

Angle /Mode	*Manf.*	*Filename*	*Scan Dir.*	*Flaw "G"*	*Flaw "H"*	*Fig.*

DETECTION (cont.): OPPOSITE SIDE EXAMINATION RESULTS (SCAN SURFACE: ID)

Angle /Mode	*Manf.*	*Filename*	*Scan Dir.*	*Flaw "G"*	*Flaw "H"*	*Fig.*

The results indicate that the is capable of detecting flaw "G" while not detecting flaw "H". Conversely, the is capable of detecting flaw "H: while not detecting flaw "G".

Conclusion:

Based on the analysis of the data collected from the demonstration block, opposite surface flaws of the size and type found in the block can be detected using the search units specified in this report.

Recommendation:

It is recommended that the transducer be used to examine the OD surface of the Pipe. See Appendix A for further information

Figure 1: Side View of CRC DM Piping Block

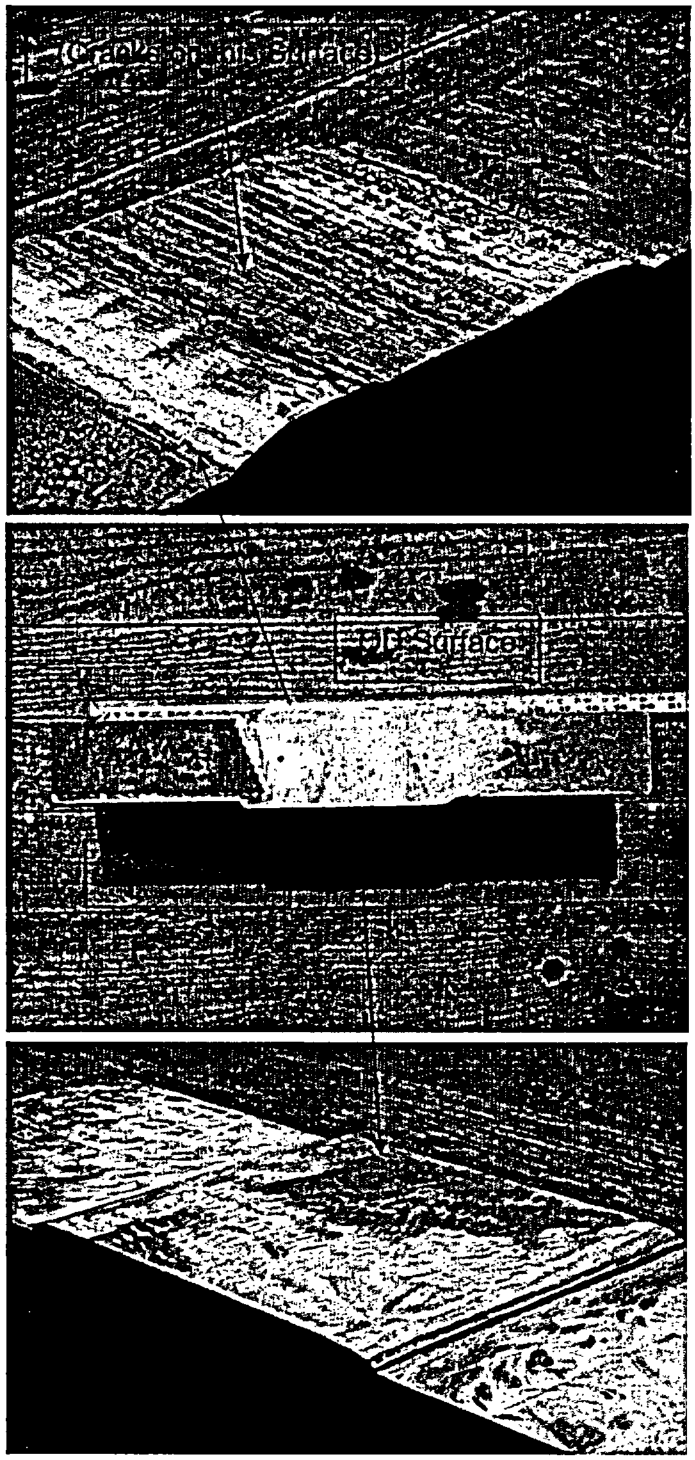


Figure 2: Framatome ANP X/Y Scanner Setup

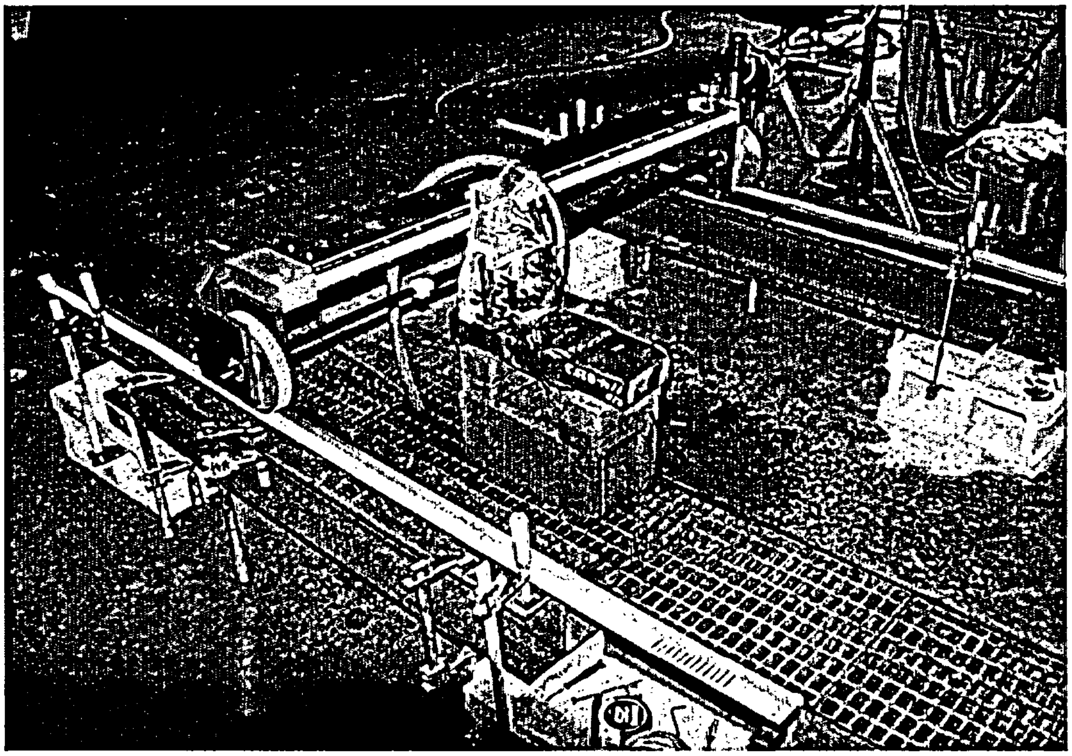
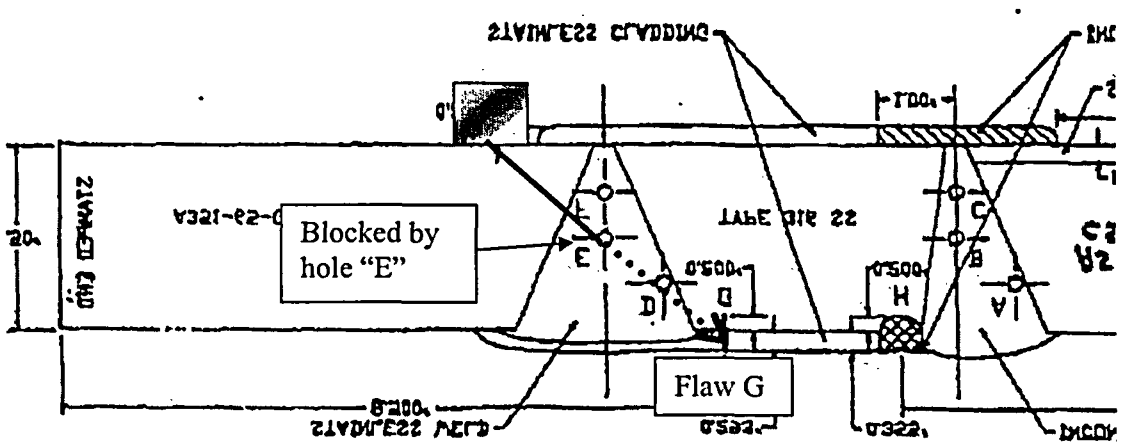
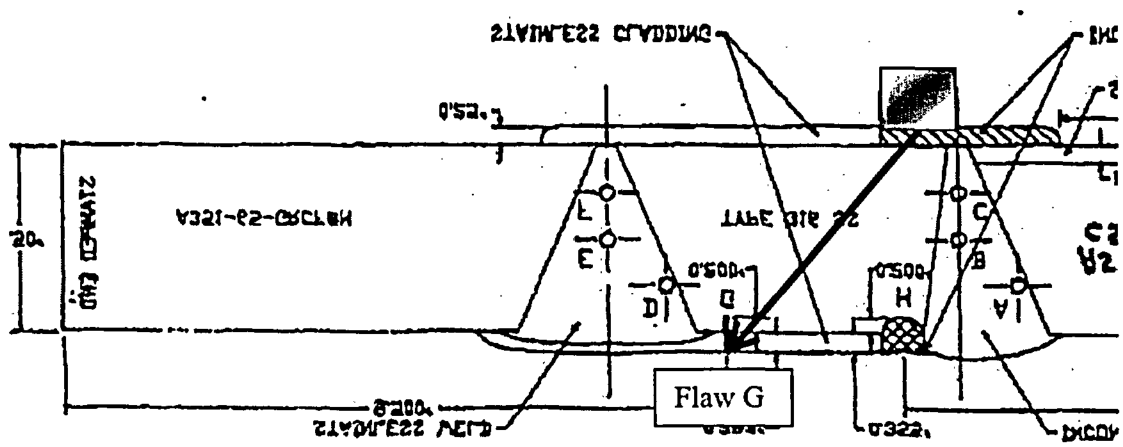


Figure 3: Opposite Side Scan Flaw "G" (Beam: X+)



Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

Figure 4: Opposite Side Scan Flaw "G" (Beam: X-)



Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

Figure 5: Opposite Side Scan Flaw "H" (Beam: Y+)

Arrow length indicates where transducer placement should be for detection

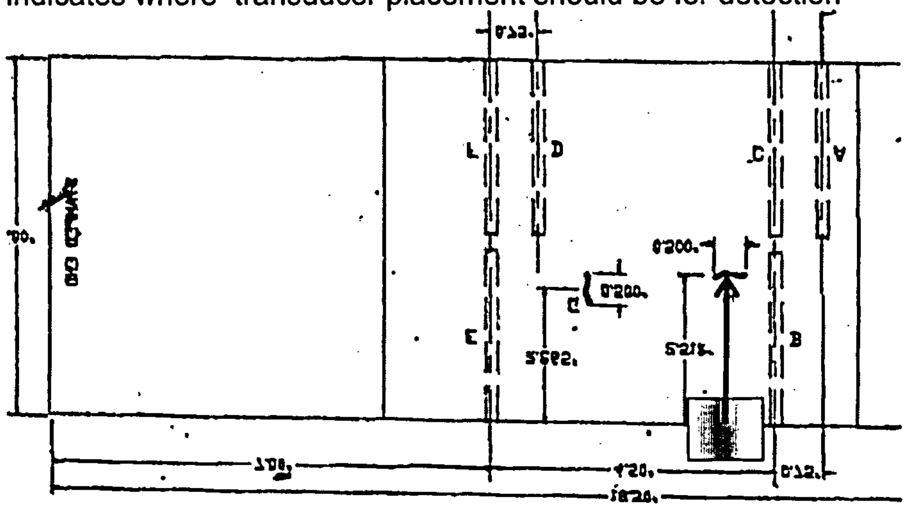


Figure 6: Opposite Side Scan Flaw "H" (Beam: Y-)

Arrow length indicates where transducer placement should be for detection.

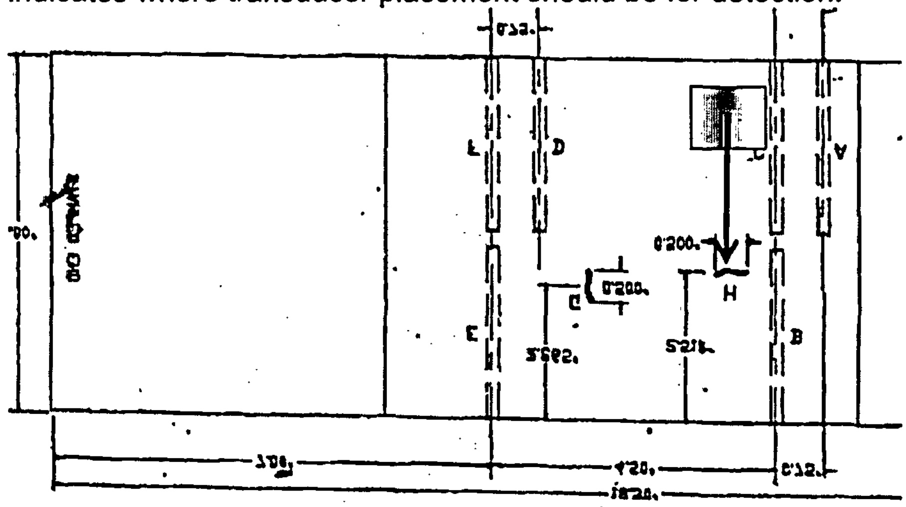


Figure 7: Opposite Side Scan Flaw "H" (Beam: Y-)

Arrow length indicates where transducer placement should be for detection.

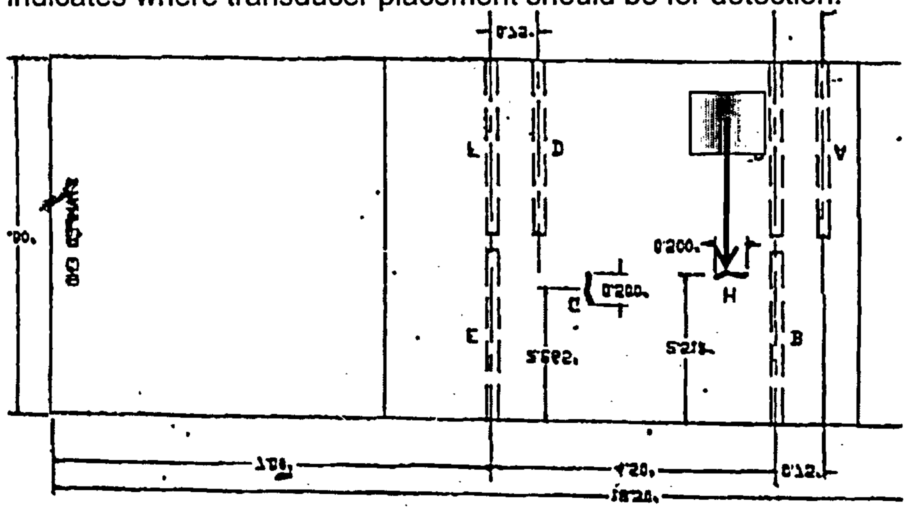


Figure 8: Opposite Side Scan Flaw "H" (Beam:Y+)

Arrow length indicates where transducer placement should be for detection

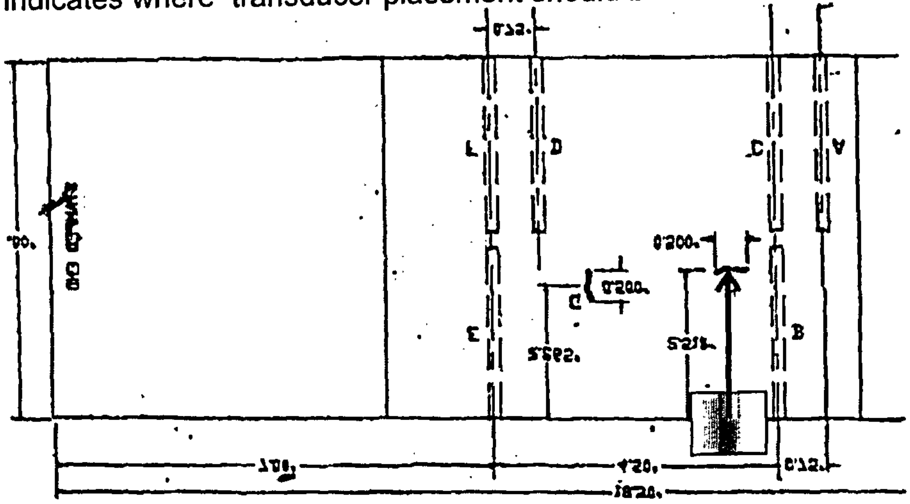
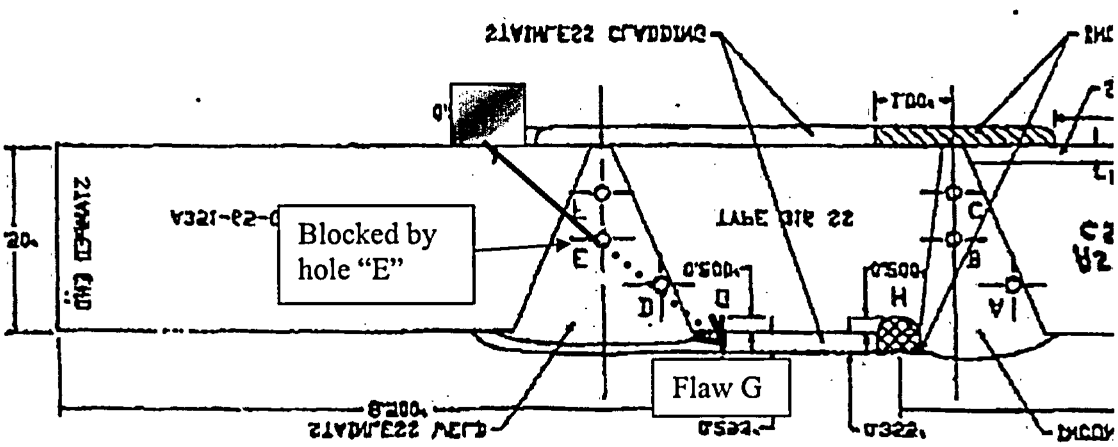
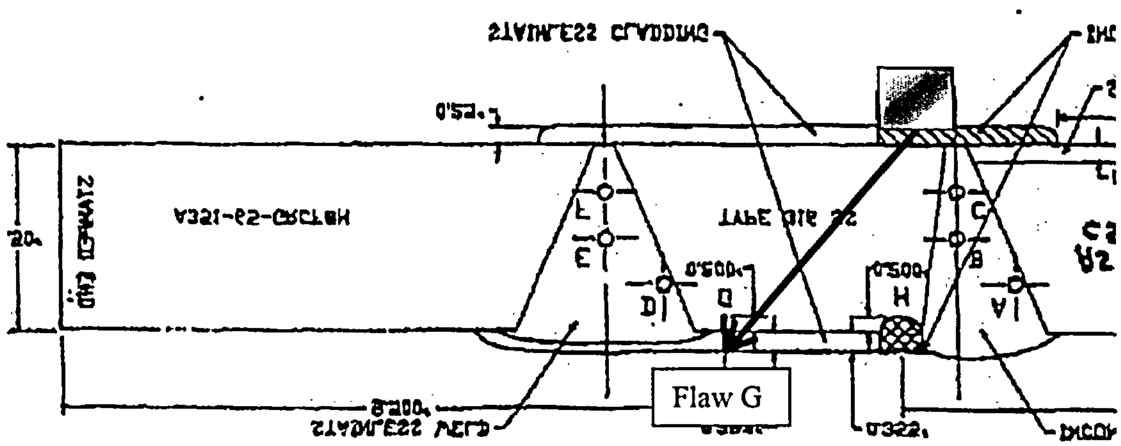


Figure 9: Opposite Side Scan Flaw “G” (Beam: X+)



Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

Figure 10: Opposite Side Scan Flaw "G" (Beam: X-)



Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrow indicates beam propagation.

APPENDIX A: TRANSDUCER RESULTS

Background:
Previous experience using for flaw detection through austenitic welds indicate that ultrasound penetration can be limited. In those cases, are frequently used to provide penetration through the welds.

Summary:
The results of the demonstration show that all side drilled holes were detected.

Demonstration Setup:
Same demonstration setup as used during the crack detection.

The following transducers were used for detection of side drilled holes:

ID SURFACE (OPPOSITE SIDE FLAWS)					
Manf	*Angle*	*Freq.*	*Size*	*Focal Depth*	*Model*

The did not show consistent or repeatable detection of the side drilled holes and therefore will not be included in this work scope.

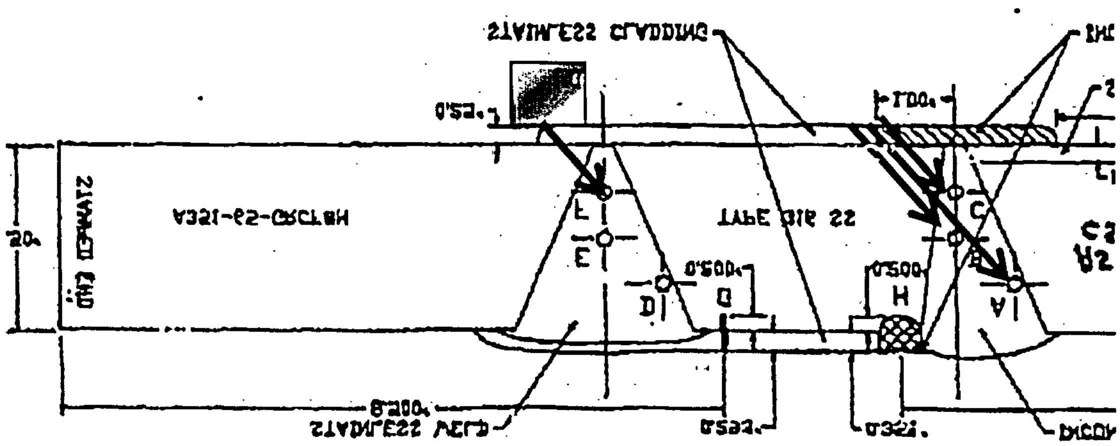
Results:
The side drilled hole detection results are presented in the following table:

Angle /Mode	*Manf.*	*Filename*	*Scan Dir.*	*Side Drill Hole*						*Fig.*
				A	*B*	*C*	*D*	*E*	*F*	

†Detection not possible due to component configuration.

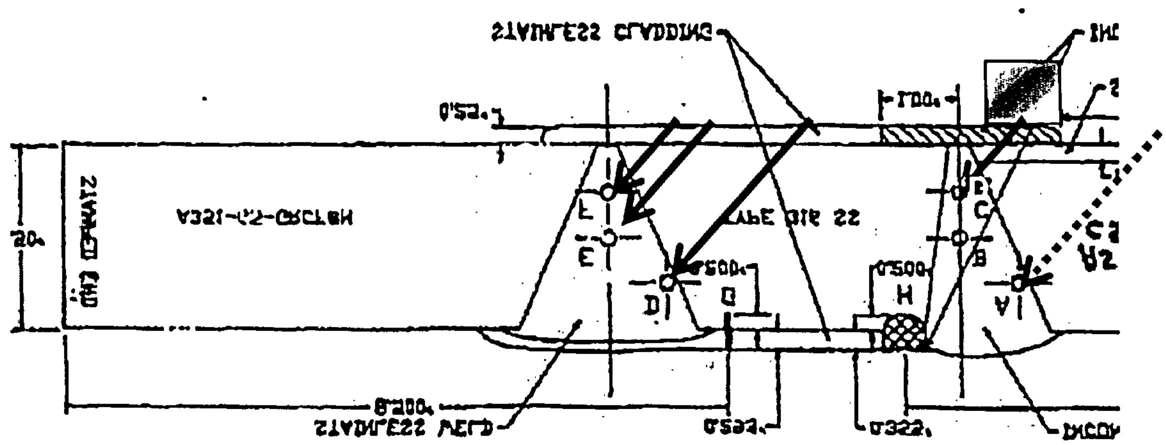
Recommendation:
It is recommended that the transducers be used in conjunction with the transducer to assure adequate penetration through the welds that make up the component.

Figure 11: "ID" Side Scan with (Beam: X+) Holes "A", "B", "C" and "F"



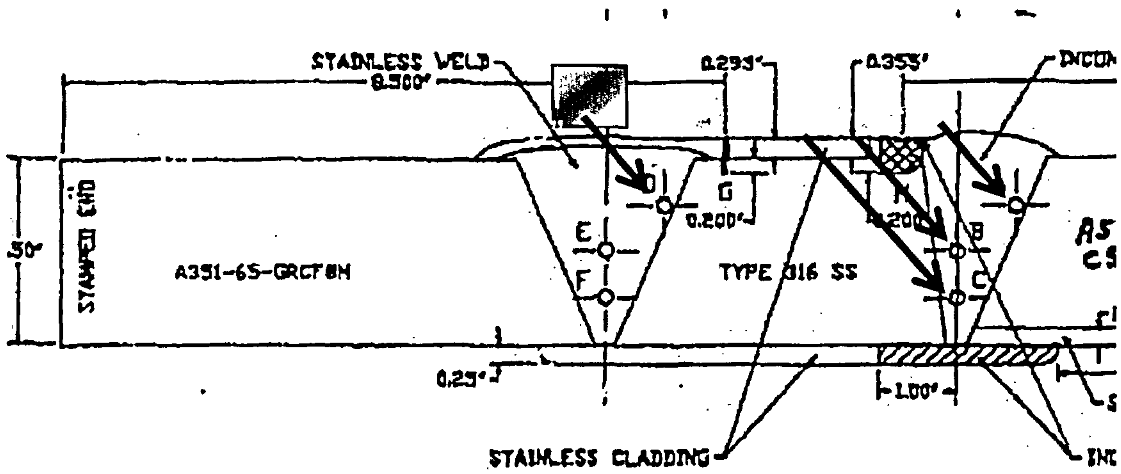
Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Arrows indicate beam propagation.

Figure 12: "ID" Side Scan with (Beam: X-) Holes "A", "C", "D", "E" and "F"



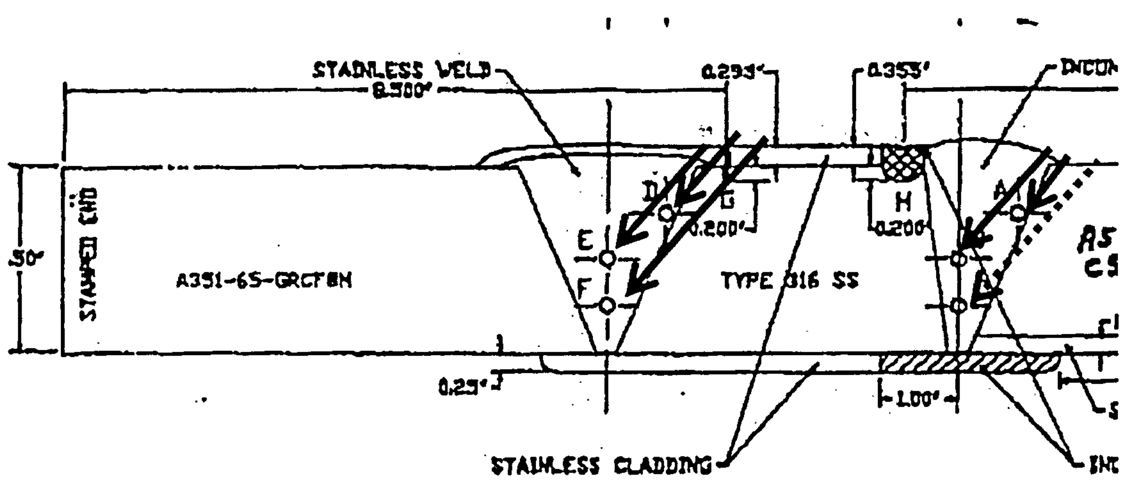
Cross section shown in reverse to demonstrate location of scanning transducer. Original drawing scanned then mirrored. Hole "A" detected off clad surface. Arrows indicate beam propagation.

Figure 13: "OD" Side Scan with (Beam: X+) Holes "A", "B", "C" and "D"



Arrows indicate beam propagation.

Figure 14: "OD" Side Scan with (Beam: X-) Holes "A", "B", "C", "D" "E", AND "F"



Hole "C" detected off clad surface. Arrows indicate beam propagation.

ATTACHMENT F

Non-Proprietary Version
Of
Framatome Procedure Number
54-ISI-189-00

ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws

FRAMATOME ANP

FRAMATOME ANP
NONDESTRUCTIVE EXAMINATION PROCEDURE

ID Automated Ultrasonic Examination of Welds for Detection of OD Initiated Flaws

Procedure Number
54-ISI-189-00

Issue Date: September 16, 2003

Prepared by: ______________________ 9/16/2003
M. W. Key Level III

Approved by: ______________________ 9/16/2003
M. G. Hacker Level III

Record Of Revision

Rev.	Page #	Para. #	Description of Change
00	All	All	Initial Issue

TABLE OF CONTENTS

1. Scope

1.1 This procedure shall govern the automated contact ultrasonic examination for OD initiated flaws in full penetration dissimilar metal piping welds and wrought, austenitic piping welds and adjacent base material by scanning from the ID surface.

1.2 The objective of the examinations performed in accordance with this procedure is to detect and characterize outside surface connected service induced discontinuities within the specified examination area.

1.3 Where accessible, examinations shall be performed from both sides of the weld with the beam directed perpendicular and parallel to the weld.

1.4 This procedure has been demonstrated by scanning the inside surface of shop weld configurations containing clad on both the ID and OD surfaces.

2. Surface Preparation

2.1 This procedure has been demonstrated using as-welded component configurations. However, if ultrasonic coverage of the required examination volume is limited due to surface conditions, the conditions shall be documented and reported to the owner for disposition.

3. Personnel Qualifications

3.1 There are three basic categories of personnel involved in performing this examination. They are calibration personnel, data acquisition personnel, and data analysis personnel described as follows:

3.2 **Calibration Personnel** are responsible for performing the ultrasonic calibrations and calibration checks and shall be qualified to at least Level II or higher in accordance with the Framatome ANP written certification practice. These personnel shall have received special training in the use of the automated data acquisition (ACCUSONEX™) system and are qualified to establish calibrations in accordance with specific procedure requirements. A qualified UT Level II or Level III data analyst must review calibrations or calibration checks.

3.3 **Data Acquisition Personnel** are responsible for operating the data acquisition system do not require training or certification in the ultrasonic method because their activity is limited to operation of equipment only and they do not make decisions concerning system configuration or the ultrasonic data itself. Their activity is limited to operation of the system controls that execute pre-established scan plans. All equipment settings

considered essential variables can be independently verified with the recorded data by the data analyst.

3.4 **Data Analysis Personnel** are responsible for performing the data analysis functions detailed within this procedure and for assuring that all of the requirements concerning the data acquisition and analysis identified in this procedure have been met. The data analysis personnel shall be qualified to at least a Level II or higher in accordance with the Framatome ANP written certification practice.

4. Equipment

4.1 The remote ultrasonic examination equipment shall consist of an automated data acquisition and analysis system (ACCUSONEX™), an encoded manipulator, the appropriate intermediate cabling, and transducers.

4.2 ACCUSONEX™ Data Acquisition and Imaging System

4.2.1 ACCUSONEX™ consists of an automated data acquisition and an analysis system. The data acquisition system is capable of collecting and digitizing the ultrasonic data, recording time and amplitude of indications which exceed a preset recording threshold and recording the manipulator position coordinates at the time the signal exceeds the threshold. The analysis system is capable of displaying the recorded data in various formats (A-scan, B-scan, C-scan, and D-scan) to aid in analysis of the data. The ACCUSONEX™ data acquisition system consists of the components described in Table B. The ACCUSONEX™ data analysis system consists of the components described in Table C.

Table B – ACCUSONEX™ Data Acquisition System

Item	Component	Model Number
1		
2		
3	ACCUSONEX™ Data Acquisition Software	
4	ACCUSONEX™ Calibration Software	
5	Computer System with Storage Device	

Note: Items 1, 2, 3, and 4 are considered essential variables of the acquisition system. Later versions of the ACCUSONEX software (items 3 and 4) may be

used if the revision does not affect the derivation of amplitude and/or time values of the recorded data.

Table C – ACCUSONEX™ Data Analysis System		
Item	**Component**	**Model Number**
1	Computer System	
2	Storage Device	
3	Color Printer	
4	ACCUSONEX™ Data Analysis Software	

Note: Item 4 is considered an essential variable of the analysis system. Later version of the analysis software may be use if the revision does not affect the imaging displays, the derivation of amplitude, and/or the time values of the recorded data.

4.3 Manipulator

4.3.1 An encoded manipulator shall be used. The manipulator shall be capable of providing positional data from a given reference mark, have the ability to control transducer positioning relative to component axis, and provide adequate force to keep the transducer coupled to the scan surface. The manipulator shall be capable of performing scanning and indexing requirements in accordance with this procedure.

4.4 Transducer Cables

4.4.1 The interconnecting cable consists of RG-174 (co-axial) cables.

4.5 Transducers

4.5.1 Transducers listed in Table D are qualified for use with this procedure. Transducers selection shall be based upon the intended application from the following table.

Table D Transducer Selection						
Mfg. /Model	**Nominal Angle/Mode**	**Nominal Frequency**	**Style**	**Focal Depth**	**Element Size/Shape**	**Application**

4.6 Water shall be used as the couplant to perform the calibrations and the examinations.

4.7 Reference Blocks

4.7.1 Transducer exit point verification shall be performed using a stainless steel IIW or Rompus block.

4.7.2 Verification of transducer refracted angle, establishing a linear time base, and establishing a reference level for subsequent examinations shall be performed using a stainless steel Side Drilled Hole calibration block similar to the design shown in Figure 2.

4.7.3 Calibration confirmation checks shall be performed on radius blocks capable of producing repeatable signal responses within the calibrated time base.

5. Areas of Interest

5.1 The specified examination volume consists of the weld and 1/2" of base material on both sides of the weld for a depth of ½" as illustrated in Figure 3.

5.2 Limitations to the examination volume described in Figure 3 shall be documented in the examination report.

6. Scan Plan

6.1 Prior to the examination, scan plans shall be developed to ensure the required examination area is scanned with the proper scanning parameters.

6.2 The component geometry shall be reviewed to determine coverage and scan distances. As a minimum the Scan Plan shall identify the scan coordinates that bound the area to be scanned and the transducer head layout with the corresponding transducer offset for each transducer.

6.3 The scan plan shall be reviewed by a data analysis qualified in accordance with paragraph 3.4 to ensure that the requirements of this procedure have been met. No adjustments may be made to the scan parameters after the scan plans have been established without the concurrence of a qualified data analyst.

6.4 Scans will be designated by a Scan Identification Number (SIN) and Subscan Identification to allow the analyst to determine the area examined. The scan identification number and subscan identification shall be identified on the scan plans.

6.5 Scanning shall be performed in a raster pattern in both the axial and circumferential directions. A typical transducer head arrangement used for the examination is shown in Figure 4.

6.6 The following parameters listed in Table E shall be used to establish the scan plan database.

Table E
UT System Parameters

System Parameter	Transducer			Comments
RF				
Threshold (RG)				This is the minimum amplitude that a peak must have to be recorded at *RUN* gain.
Gain Adjust				
Coincidence				This value establishes the number of sequential waveforms that will be compared point by point before feature extraction algorithms are applied.
Rect. Mode				
Threshold (CG)				This is the minimum gain normalized amplitude that a peak must have to be to be recorded.
Delay				This feature permits the insertion of a delay between subsequent pulses if it is determined that the pulse repetition rate is too high. The value is measured in ms. Normally; a value of 0 is used unless evidence of wrap-around is noted in the data. If wrap-around is noted, increase the delay value in .1 ms increments until the signal disappears.
PR Mode				
Pulse Width				
Pulser Source				
Pulser Voltage				The pulser voltage for the surface profile scan may be ensure that the surface response is not saturated.
Gain Boost				
Scan Speed				The systems ability to keep up with recording UT data is a function of several variables and can be controlled by reducing the scan speed. The data analyst can determine during the analysis of the data file if the scan speed was to fast for the system to record the data of interest that are indicated as intermittent areas of no data along the scan line that is not contributed to coupling effects. If the analyst determines the data is unacceptable due to an excessive scan speed a rescan shall be performed at a slower scan speed.
Index Increment				
Sync. Interval				This is the interval at which data is collected along the scan line. The pulse repetition rate is a function of the speed at which the ACCUSONEX™ data acquisition system can be configured to take multi-channel data during automatic operation. The pulse repetition rate is set by the delay and length of the acquire window and the processing time for each A-scan. The pulse repetition rate is not available to the operator as an adjustable control on the system. For the circumferential directed probes, the sync. Interval shall be converted to degrees based on the largest diameter being scanned.
Active Channel				Select the channels that are to be active during the scan.
Display Channel				Activates the channel to be displayed during acquisition.

7. System Calibration

7.1 The amplifier vertical and amplitude control linearity shall be verified before and after examining all welds required to be examined. Linearity shall be verified using the digitized waveform provided by the data acquisition system.

7.1.1 Vertical Linearity

7.1.1.1 The ability of the amplifier to provide a linear output for 100 percent of the vertical range shall be verified by the following steps:

7.1.1.1.1 Position a search unit so that echoes can be observed from any two reflectors in a material.

7.1.1.1.2 Adjust the search unit position to give a 2-to-1 ratio of the amplitudes between the two echoes with the larger set at 100% full screen height (FSH) and the smaller at 50% FSH.

7.1.1.1.3 Without moving the search unit, reduce the gain in 2 dB increments to decrease the larger echo to at least 20% FSH and record the amplitude of the smaller echo on the Instrument Control Linearity Sheet.

7.1.1.1.4 The amplitude of the smaller reading must be 50% of the larger reading within ±5% FSH. The settings and readings must be estimated to the nearest 1% of FSH.

7.1.2 Amplitude Control Linearity

7.1.2.1 The linearity of the amplitude controls of the ultrasonic instrumentation shall be verified using the steps outlined below.

7.1.2.1.1 Position a search unit so that an echo can be observed from a reflector in a material.

7.1.2.1.2 With the increases and decreases in the stepped gain control shown in the following table, the indication must fall within the specified limits below:

Indication set at % of FSH	dB Control change	Indication limits, % of full screen
80%	-6 dB	32 to 48%
80%	-12dB	16 to 24%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%

7.2 A static or dynamic calibration shall be established for each transducer utilizing the applicable reference block using the peak amplitude of the reflectors to develop the appropriate sweep range and reference level.

7.3 Transducer exit points shall be measured and documented prior to use using either a rompus or IIW block meeting the requirements of paragraph 4.7.1. The refracted angle shall be checked and documented using a side drilled hole that produces the highest amplitude response in order to obtain an accurate and repeatable measurement.

7.4 Prior to calibration the following system parameters that effect the calibrations shall be set for each applicable setup and channel in accordance with Table F.

Table F
UT System Parameters

System Parameter	Transducer			Comments
XDCR Freq. (Filter)				
TR Freq. (Digitization Rate)				
Rect (Rectification Mode)				
Coincidence Mode				This value establishes the number of sequential waveforms that will be compared point by point before feature extraction algorithms are applied

7.5 Calibrations may be performed using different cables between the acquisition system and the transducer as compared to the configuration used for actual scanning. When separate cables are used for the calibrations they shall consist of the same cable type, lengths (± 6 feet), and number of intermediate connectors as those used for the examination. When performing the calibrations with different cables then those used for the examination, a comparison of signal responses (time and amplitude) between the calibration and examination cables is required for the complete system (cable, intermediate connectors, , and transducer) for each applicable channel. When required, the cable comparison shall be performed in accordance with the following paragraphs.

7.5.1 Upon completion of the system calibrations, a baseline response shall be documented for the complete system (cable, intermediate connectors, remote pulser, µtomo, and transducer) for each applicable channel. This is performed using a rompus block meeting the requirements of paragraph 4.7.1.

7.5.2 The response from the radius of the rompus block shall be maximized and recorded for comparison to the examination cable. The time and amplitude shall be documented by printing the A-scan image of the response that shows the gain level, signal amplitude, and depth/µseconds of the reflector.

7.5.3 When the examination system is configured with the cable configuration to be used for the examination, the response from the rompus block radius shall be captured again with the examination cables in accordance with paragraph 7.5.2.

7.5.4 The response shall be compared to determine if any compensation for amplitude or time is required prior to performing the examination.

7.5.4.1 Any variation in amplitude greater than dB shall be compensated for by adjusting the calibration gain level by the amount determined from the comparison for each channel requiring adjustment.

7.5.4.2 Any variation in time greater than. shall be compensated for by adjusting the position of each calibration point by the amount determined from the comparison for each channel requiring adjustment.

7.6 Time Base Calibration

7.6.1.1 A calibrated time base shall be established for the angle beam transducers using the nominal reflectors from a reference block that meets the material requirements of paragraph 4.7.2. Mark their position and amplitude using the location markers in the calibration window, then adjust the markers to % FSH and save the setup.

7.7 Enter the appropriate calibration information (Transducer ID, manufacture, calibration block, etc.) in the calibration header.

7.8 Calibration Gain (Cal Gain)

7.8.1 The primary reference sensitivity (Cal Gain) for the angle beam transducers will be established using the peak amplitude from a hole reflector located block for each transducer. Adjust the response to % (+/- 5%) FSH. This shall be the level to be used for examinations.

7.9 Scanning sensitivity (run gain) for each inspection angle shall be set.

7.10 The acquire window (relative to the gate start position) establishes the range of data to be recorded by the data acquisition system.

7.10.1 The acquire window shall start at a depth of and extend to at least" beyond the thickness of the material. The component shall be considered when establishing the required range.

7.11 Calibration Confirmation

7.11.1 Upon completion of the initial system calibrations, the calibration confirmation baseline shall be established. This is performed by copying the initial calibration setup to a setup designated to be used for the calibration checks.

7.11.2 Perform a scan of the reference blocks meeting the requirements of paragraph 4.7.3 with each transducer using the designated calibration setup. The same block shall be used for all subsequent measurements. However, the same block need not be used for each transducer.

7.11.3 In the analysis mode, use the beam select feature to capture two reflectors that will be used to measure amplitude and depth responses. Record these values for reference. This baseline response will be used to evaluate future performance of the complete system during the confirmation checks.

7.11.4 Perform all subsequent calibration checks in the same manner and record the amplitude and depth responses.

7.11.5 Intermediate calibration checks shall be performed at approximately, when cable changes are made from the initially calibrated set, or at any point where the analyst suspects malfunction of the system.

7.11.6 A final calibration check shall be performed on the reference block upon completion of examinations.

7.11.7 Signal response during calibration checks or the final calibration must be within " of the initial sweep reading and dB of the initial amplitude response. If any of the reference points fail to meet these requirements, the following steps shall be completed:

7.11.7.1 All examinations since the last successful calibration shall be evaluated by a qualified analyst to determine the effects of the calibration check results. Rescans shall be issued for any data that is evaluated as deficient.

7.11.7.2 Correct the calibration for future data collection.

8. Scanning Requirements

8.1 The temperature of the component to be examined shall not exceed 120° F.

8.2 The scanner shall be calibrated to provide accurate positional information in relationship to the component. This will be accomplished by using the applicable operating instruction (OI) for the scanner being used for the examination.

8.3 The system operator shall select the appropriate scan plan to be executed from the previously entered database.

9. Data Analysis

9.1 Refer to Figure 5 during data analysis for a flow chart of the analysis process

9.2 Weld fabrication and examination data histories, if available, shall be reviewed prior to analysis of the ultrasonic examination data.

9.3 Following the completion of scanning, the ultrasonic data shall be reviewed to assure that the data quality (contact, signal to noise, coupling, etc.) is adequate to properly perform an effective evaluation of the examination data. The data shall also be reviewed to verify that the scanning parameters specified in Sections 6 and 7 were utilized and sufficient. If any of the scan parameters require adjustment, the scan plan shall be revised and rescans performed as necessary. All subsequent scanning shall be made using the revised parameters.

9.4 The analyst shall update and apply the geometry file by inputting the beam angle, beam direction, transducer offsets, and component geometry as applicable, (refer to the scan plan) for each scan to assure that the proper location of indications are reported.

9.4.1 Curvature correction shall be applied to adjust the data to the proper depth and circumferential position when using flat calibration blocks.

9.4.2 The transducer beam orientation is used to set the transducer beam direction with respect to the index coordinates for the specific channel. The range of this parameter is 0 to 360 degrees. The +X orientation is 0 degrees and means that the transducer beam direction is in the positive index direction. Likewise, the -X orientation is 180 degrees and is the negative index direction. The analyst can verify that the correct beam direction orientation has been entered by verifying that the proper target motion is display on the screen based on the scan plan information.

9.5 The recorded data shall be analyzed to the extent that the analyst can determine the classification and location of the indications that meet the data recording criteria.

Indications are defined as coherent patterns of signals observed in the B, C, or D-scan images that exhibit target motion in the beam direction. The following steps should be followed in the initial evaluation process of the ultrasonic data to aid determining the origin of the recorded reflectors.

9.5.1 Recall the data for the channel being analyzed. Using the "expand" feature, display the weld volume from a point at least" before the component OD surface to ~ past the OD surface.

9.5.2 Adjust the color palette range to provide resolution of the various reflectors throughout the scan. Several palette ranges should be evaluated in order to provide optimum image contrast. Too small of a color range may mask flaw indications with the background noise of the component, while too large of a palette range may not properly display low amplitude indications.

9.5.3 Investigate areas of suspect indications in accordance with paragraphs 9.7 and 9.8. At this point the data that projects into the examination volume should be investigated to view the full target motion of the suspected surface connected flaws. For weld configurations that produce geometric responses due to the inside surface the data shall be evaluated with beam angle correction applied and removed to properly evaluate potential flaw indications that may be obscured by the geometric responses. This allows the analyst to identify indications that have target motion, which may have been obscured in the angle corrected views.

9.6 Indications shall be classified as either geometric or non-geometric (flaw indications). The following paragraphs provide some general guidelines when evaluating examination data with suspected geometric indications.

9.7 Geometric indications are likely to be detected from weld counterbores and weld roots when the beam is directed toward the reflector. This type of indication will normally exhibit a fairly continuous pattern in the D-scan and C-scan images and may be localized in areas or extend a full 360° around the weld. Geometric indications usually exhibit consistent target motion across the length of the indication. For the examinations being performed in accordance with this procedure from the inside surface, geometric indications are usually detected for shop weld configurations from weld root or counterbore conditions. Care should be taken when analyzing data near geometric indications as they may obscure flaw signals.

9.8 Indications that cannot be dispositioned as geometric indications and meet the applicable criteria specified below shall be classified as flaw indications.

9.8.1 Flaw indications usually exhibit themselves as localized areas and peak amplitudes greater than.

9.8.2 The intent of this procedure is to detect outside surface connected cracks, however the techniques utilized may also detect other types of flaws which have length and depth (lack of fusion, slag) that have to be evaluated by the analyst.

9.8.3 Cracks are surface connected and may appear as isolated indications or multiple related indications within the examination region. When a flaw indication is embedded in a high amplitude surface geometric response the target motion of the flaw response will normally extend through the geometric response.

9.8.3.1 The position of the flaw in relationship to the transducer position, geometric configuration restrictions, flaw orientation (tilt and skew) and position (side of the weld) will affect the flaw response, i.e. a surface flaw may not provide target motion to the surface if the geometry restricts transducer contact over the flaw or the flaw orientation is not favorable to the side of the weld where the transducer is positioned, etc. Questionable indications shall be evaluated from both sides of the weld to ensure proper interpretation of the data.

9.8.4 Non-geometric indications that connect to the outside surface shall be considered planar type flaws. Indications that produce images, which display target motion that extends to or beyond the outside surface, (when viewing the B and D scan displays), shall be considered surface connected indications.

10. Data Recording

10.1 The reflector position, depth, and amplitude at the point of maximum amplitude shall be documented for geometrical or fabrication type indications 50% or greater than the primary reference level. These shall be identified as geometric or fabrication indications on the data sheet. These types of indications are recorded for reference only when comparing past and future examination results.

10.2 Surface connected flaw indications shall be reported regardless of amplitude. Data from other scan directions and/or transducers should be used to confirm the presence of flaw indications where possible.

10.3 The location, amplitude, and length shall be documented for each flaw indication as described in the following paragraphs:

10.3.1 The location of the flaw along the pipe axis (for circumferential flaws) or around the circumference (for axial flaws) shall be recorded. The surface position shall be measured at the point where the target motion intersects the outside surface of the component. Where the target motion of a surface connected flaw does not extend to the outside surface due to flaw position relative to the

geometry, extend the target motion following the same angle until it intersects the outside surface to determine the flaw position.

10.3.2 Record the maximum amplitude of the indication. For many flaw indications the flaw response may be saturated. If the flaw response is saturated, record the maximum measured amplitude and also indicate that the flaw response is saturated.

10.3.3 Length:

10.3.3.1 For determining the flaw end points the B-scan should be expanded to display the outer 1.0" of material to properly provide the surface position of the indication. Length measurements should be taken at the end points along the flaw axis where the flaw image.

10.3.3.2 For length sizing of circumferentially oriented flaws the measurements shall normally be taken from the flaw orientation or surface geometry condition provides a better response.

10.4 Areas of limited examination coverage shall be recorded in the examination report. Limitation of coverage of the examination volume from the inside surface of the component is usually due to surface geometry that does not allow the transducer to be scanned over the surface or maintain contact. These regions can be identified using the B, C, and D-scan images. To determine the amount of limited coverage measure the areas of transducer liftoff on the image. Both the axial and circumferential extents shall be documented for each transducer and beam direction. The surface profile scan may be performed if more detailed evaluation of the surface condition is required to provide a more precise estimate of limited coverage.

11. Rescans/Supplemental Scans

11.1 The analyst may identify additional scans in order to satisfy the requirements of this procedure or to re-perform scans of areas that are considered inadequate.

11.2 Supplemental examinations, performed in addition to the examinations required by procedure, are acceptable to provide additional information to help resolve or confirm results, provided they are not used to overturn results obtained with the qualified techniques or provide additional coverage of limited areas.

11.3 Data analysis personnel shall be responsible for initiating all instruction for Rescans or Supplemental scans.

12. Reporting

12.1 The results of the examination shall be reported to the customer. All indications shall be individually processed and evaluated by a qualified analyst. Any area where limited or no examination was performed shall be documented and reported to the customer. A copy of the examination data shall be provided to the customer. As a minimum the following information shall be included;

12.1.1 Scan plan

12.1.2 Calibration records

12.1.3 Date and time of calibration, calibration checks, and examination

12.1.4 Names of and certification levels of examination personnel

12.1.5 Examination procedure number and revision

12.1.6 Calibration block identification

12.1.7 ACCUSONEX™ data acquisition system identification number

12.1.8 Transducer frequency, size, angle, mode, and serial number

12.1.9 Cable type, length, and number of intermediate connectors

12.1.10 Calibration reflector amplitude and depth values

12.1.11 Acquisition and analysis software versions

12.1.12 Couplant

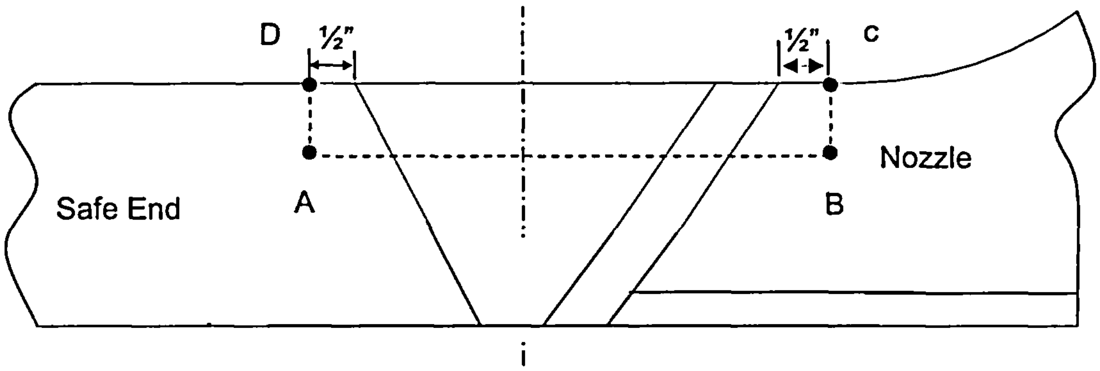
12.1.13 Weld identification

12.1.14 Examination surface

12.1.15 Beam orientation in relationship to the pipe

Figure 1
Typical Qualified Cable Configuration

Figure 2 - Typical Calibration Standard



Examination Volume for Dissimilar Metal Welds A-B-C-D

Figure 3 - Examination Volume

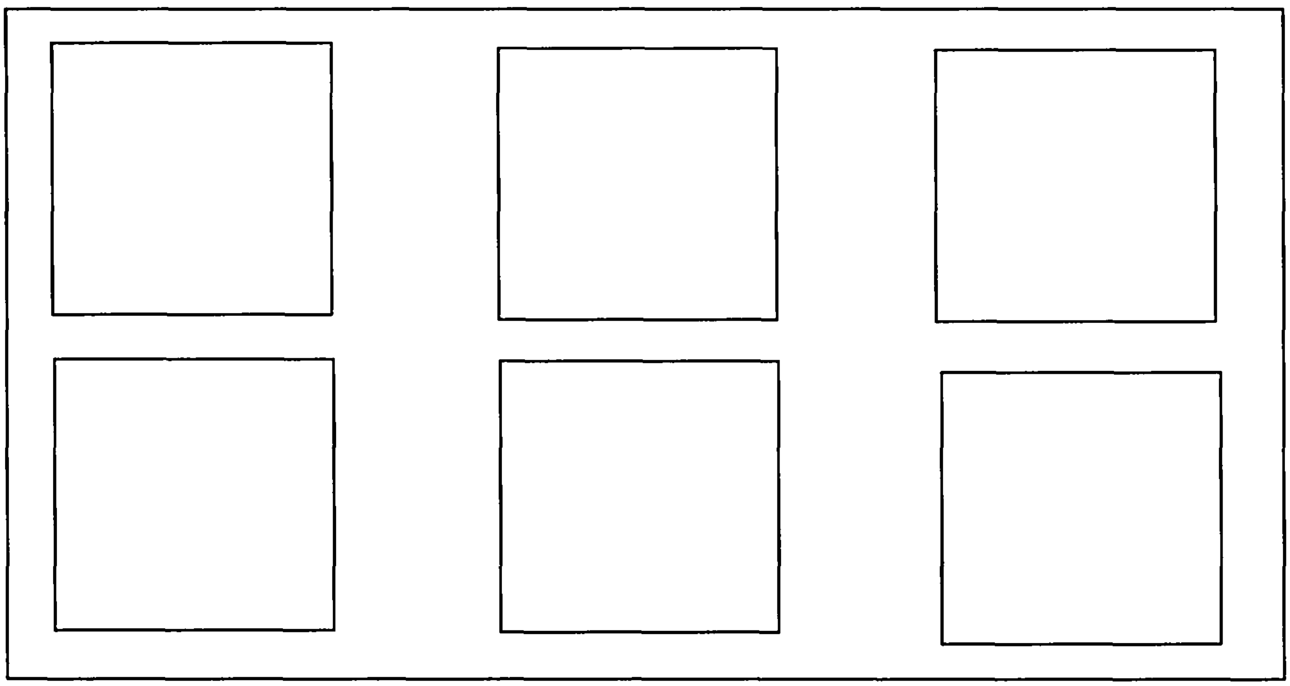


Figure 4
Typical Transducer Head Arrangement

Figure 5 - Data Analysis Flow Chart

Attachment G

Commitment Summary

Commitment Action:

To implement the requirements consistent with ASME Code Case N-615, "Ultrasonic Examination as a Surface Examination Method for Category B-F and B-J Piping Welds" for the surface examinations for the six (6) Reactor Pressure Vessel nozzle-to-safe end dissimilar metal welds, category B-F, item B5.10 for nozzle inspections performed during the 2003 refueling outage.