Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-4704

Stephenie L. Pyle
Manager, Licensing
Arkansas Nuclear One

2CAN091205

September 10, 2012

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

SUBJECT: Response to Second Request for Additional Information
Request for Alternative ANO2-ISI-007
Code Case N-770-1 Baseline Examination
Arkansas Nuclear One, Unit 2
Docket No. 50-368
License No. NPF-6

REFERENCES:

1. Entergy letter dated November 30, 2011, "Use of Alternate ASME Code Case N-770-1 Baseline Examination Request for Alternative ANO2-ISI-007" (2CAN111101) (ML113340158)

2. NRC email dated February 23, 2012, "RAI for the Request to use Alternate ASME Code Case N-770-1 Baseline Examination, Request for Alternative ANO2-ISI-007" (TAC No. ME7646) (ML120541089)

3. Entergy letter dated April 13, 2012, "Response to the Request for Additional Information Regarding Request for Alternative ANO2-ISI-007 Code Case N-770-1 Baseline Examination" (2CAN041202) (ML12104A066)

4. Entergy letter dated May 21, 2012, "Additional Information Related to Request for Alternative ANO2-ISI-007 Code Case N-770-1 Baseline Examination" (2CAN051202) (ML12142A319)

5. NRC email dated August 28, 2012, "RAI for the Request to use Alternate ASME Code Case N-770-1 Baseline Examination, Request for Alternative ANO2-ISI-007" (TAC No. ME7646)

Attachment 1 to this letter contains proprietary information – Attachment 1 is withheld from public disclosure per 10 CFR 2.390.

AC47
NRR

Dear Sir or Madam:

Entergy Operations, Inc. requested NRC approval of a Request for Alternative for Arkansas Nuclear One, Unit 2 via Reference 1. The request is associated with the use of an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Code Case N-770-1, as conditioned in the Final Rule 10 CFR 50.55a(g)(6)(ii)(F)(3), dated June 21, 2011.

In Reference 2, the NRC determined that additional information was needed to complete the review of Reference 1. Reference 3 provided the requested information. Subsequently, a conference call was held with the NRC on April 26, 2012, to discuss the responses provided in Reference 3 and to clarify a portion of the request in Reference 2. Based on this conference call, it was determined that further information was required. The additional information was provided in Reference 4.

Based upon further review, the Staff requested additional information to complete the review (Reference 5). The purpose of this submittal is to provide that information.

Some of the information contained in Attachment 1 is considered proprietary to Structural Integrity Associates, Inc. (SI). SI requests that the proprietary information be withheld from public disclosure in accordance with 10 CFR 2.390. SI has provided Entergy with authorization to provide the proprietary information. An affidavit by the information owner, SI, supporting the request for non-disclosure is provided in Attachment 2. Therefore, Entergy requests that Attachment 1 of this submittal be withheld from public disclosure in accordance with 10 CFR 2.390. A nonproprietary version of information contained in Attachment 1 is included in Attachment 3.

This submittal contains no regulatory commitments.

Should you have any questions, please contact me.

Sincerely,

SLP/rwc

Attachments:
1. Response to Second Request for Additional Information – Use of ASME Code Case N-770-1 Baseline Examination (Proprietary)
2. Affidavit from Structural Integrity Associates, Inc., dated September 4, 2012
3. Response to Second Request for Additional Information – Use of ASME Code Case N-770-1 Baseline Examination (Non-Proprietary)

Attachment 1 to this letter contains proprietary information – Attachment 1 is withheld from public disclosure per 10 CFR 2.390.

cc: Mr. Elmo E. Collins
Regional Administrator
U. S. Nuclear Regulatory Commission, Region IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

NRC Senior Resident Inspector
Arkansas Nuclear One
P. O. Box 310
London, AR 72847

U. S. Nuclear Regulatory Commission
Attn: Mr. Kaly Kalyanam
MS O-8 B1
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Attachment 1 to this letter contains proprietary information – Attachment 1 is withheld from public disclosure per 10 CFR 2.390.

Attachment 2 to

2CAN091205

Affidavit from Structural Integrity Associates, Inc.
Dated September 4, 2012

Structural Integrity Associates, Inc.®

5215 Hellyer Ave.
Suite 210
San Jose, CA 95138-1025
Phone: 408-978-8200
Fax: 408-978-8964
www.structint.com

September 4, 2012

AFFIDAVIT

I, Marcos Legaspi Herrera, state as follows:

(1) I am a Vice President of Structural Integrity Associates, Inc. (SI) and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in SI "Manual RL38 Wedge Assembly" Design Drawing 100100 Rev. 0, and "Manual RS55 Wedge Assembly" Design Drawing 100101 Rev. 0. Information from these design drawings is to be treated as SI proprietary information, because it contains significant information that is deemed proprietary and confidential to Structural Integrity Associates. The design of Structural Integrity Phased Array wedges if used by a competitor would reduce the competitor's expenditure of resources, and improve its competitive position in the design and manufacture of similar products for their use during qualification and application of Phased Array Ultrasonic Examinations.

Paragraph 3 of this Affidavit provides the basis for the proprietary determination.

(3) SI is making this application for withholding of proprietary information on the basis that such information, constitutes Trade Secrets which if used by a competitor would reduce the competitor's expenditure of resources, and improves its competitive position in the design and manufacture of similar products for their use during qualification and application of Phased Array Ultrasonic Examinations. This application for withholding of proprietary information relies upon the exemption of disclosure set forth in NRC Regulation 10 CFR 2.390(a)(4) pertaining to "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). Information for which exemption from disclosure is herein sought is considered proprietary for the following reasons:

a) 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.

I declare under penalty of perjury that the above information and request are true, correct, and complete to the best of my knowledge, information, and belief.

Executed at San Jose, California on this 4th day of September, 2012.

Marcos Legaspi Herrera, P.E.
Vice President
Nuclear Plant Services

State of California

County of Santa Clara

Subscribed and sworn to (or affirmed) before me

on this 4th (Date) day of September (Month), 2012 (Year),

by

(1) Marcos Legaspi Herrera
Name of Signer

proved to me on the basis of satisfactory evidence to be the person who appeared before me (.) (x)

(and

(2) _____
Name of Signer

proved to me on the basis of satisfactory evidence to be the person who appeared before me.)

C. METZGER
Commission # 1866327
Notary Public - California
Santa Clara County
My Comm. Expires Sep 27, 2013

Place Notary Seal and/or Stamp Above

Signature _____
Signature of Notary Public

Attachment 3 to

2CAN091205

Response to Second Request for Additional Information
Request for Alternative ANO2-ISI-007
Code Case N-770-1 Baseline Examination

(Non-Proprietary)

REQUEST FOR ADDITIONAL INFORMATION
USE OF ASME CODE CASE N-770-1 BASELINE EXAMINATION

By letter dated November 30, 2011, as supplemented by letters dated April 13, 2012 and May 21, 2012, (Agencywide Documents Access and Management System (ADAMS) Accession Numbers ML113340158, ML12104A066 and ML12142A319, respectively) Entergy Operations, Inc. (the licensee) submitted Request for Alternative ANO2-ISI-007, "Use of Alternate ASME Code Case N-770-1 Baseline Examination," for U. S. Nuclear Regulatory Commission review and authorization. The staff requests additional information to complete the review.

1. **For welds 09-008 and 10-014, please provide an analysis of the time necessary for the largest potential semicircular (thumbnail) inside diameter connected axial flaw contained in the unexamined region of the susceptible weld material to grow by primary water stress corrosion cracking (PWSCC) to:**

   The pipe to safe end weld on the suction side of "A" reactor coolant pump (RCP) was selected as the bounding case for a postulated flaw due to the amount of area that was not examined with the circumferential scan for axial flaws. The coverage sketch is considered worst case as the scan lines depicted do not factor in a +/- 10° skew that was used during the examination; therefore, the actual scan coverage was greater than that illustrated in Figure 5.

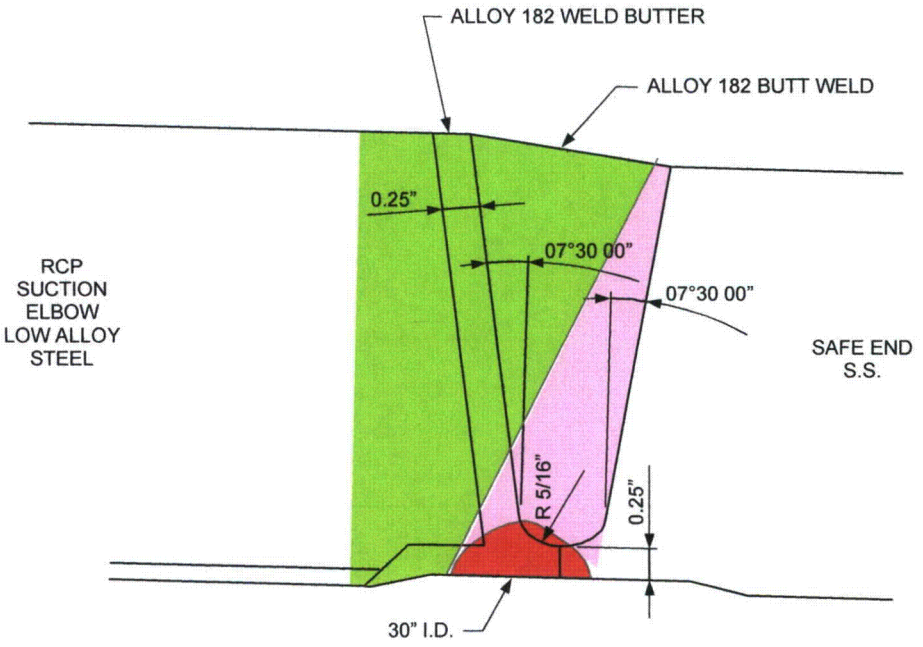
   The previous scan coverage plot was transposed over a scale drawing derived from joint design information.

   Green depicts the area of the weld joint that had full coverage for the circumferential scan.

   Pink depicts the area of the weld joint that had limited or no coverage for the circumferential scan.

   Red depicts the maximum estimated flaw that would have attributes that would have gone undetected with this scan scenario.

Figure 5



The estimated flaw is 0.50" in depth from the inside surface, which renders approximately a 15% through-wall flaw.

a. Extend far enough into the examined region to be detected

i. Describe the criteria for determining the PWSCC flaw size that can be detected using the ultrasonic examination (UT) techniques employed

The postulated flaw is the largest flaw that could exist in the un-inspected volume. Any significant growth would extend into the material that could be examined using the techniques used and described in the original submittal of ANO2-ISI-007 (ML113340158) and would be detectable in a subsequent examination.

b. Exceed American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) allowable size

Entergy Operations, Inc. (Entergy) contracted Westinghouse to perform crack growth analysis for a postulated flaw in the Arkansas Nuclear One, Unit 2 (ANO-2) RCP suction or discharge welds (Reference 1 of this attachment). This analysis concluded that the bounding condition is for a weld that had a 10% through wall repair from the

inside diameter (ID) during original fabrication. For that limiting condition, a postulated initial flaw that is 14.4 percent through wall would grow to the ASME Code allowable flaw size of 75 percent through wall in approximately six years.

c. Become through-wall

The crack growth analysis (Reference 1 of this attachment) also calculated that a postulated initial flaw that is 14.4 percent through wall would grow to 100 percent through wall in approximately seven years.

2. In order for the NRC staff to have the ability to verify the above analyses, for the two subject welds please provide:

a. Scale drawings showing the dimensions of the Alloy 82 weld root, Alloy 182 fill and butter, and the dimensions of the unexamined region at the weld root. Indicate the position of the PWSCC flaw when it can be detected

There are two basic configurations for the eight welds. One configuration is the four welds that are on the suction side of the reactor coolant pump. The other configuration is the four welds on the discharge side of the pump. The suction side weld is between an elbow and a stainless steel safe end. The pipe was fabricated from a 3.375 inch thick flat plate and the elbows were fabricated from 3.625 inch thick flat plate. The forming process results in final thickness that is typically slightly thicker than the original plate, and the final thickness varies slightly around the circumference of the pipe or elbow. The scale drawings are based on nominal values; therefore, actual measured dimensions are slightly different.

Figure 5 above illustrates the maximum volume that could not be examined for axial oriented flaws and depicts that a flaw larger than that indicated in red (thumbnail) would extend into the examination volume and become detectable.

Figures 6 and 7 provide the scale drawing of each of the two basic configurations.

b. Diameter, wall thickness and material on each side of the dissimilar metal weld

See Table 1.

c. Length of the cast austenitic stainless steel safe end

See Table 1.

d. Information on any post-weld machining, including back chipping and rewelding on the inside diameter, and documented weld repairs

The typical fabrication practice for these welds was to back-grind the root of the weld to sound metal from the inside surface and re-weld flush with the ID. This fabrication practice is equivalent to performing an ID repair to a depth of approximately eight percent of the wall thickness for the full 360 degrees around the pipe / elbow. Entergy has performed a due diligence review of its records and no documentation of repairs made during the fabrication of the subject welds could be located.

e. Stress field description at the weld

Stress profiles for the subject welds are provided in Reference 1 of this attachment, which will be submitted under separate cover.

f. Operating temperature and pressure

The normal operating temperature for these pipes varies from 545 °F at 0% full power to 551 °F at 100% full power.

The average pressurizer pressure is between 2025 and 2275 psia in accordance with ANO-2 Technical Specification 3.2.8. Continuous operation below 2150 psia is limited to less than 24 hours. Normal operating pressure is 2200 psia.

3. The staff requests information concerning the subject UT examinations

a. From statements in the licensee's submittals, it appears that the ultrasonic procedure, equipment and personnel employed were qualified through the industry's Performance Demonstration Initiative (PDI). Confirm that all aspects of the subject qualifications have been through blind qualification in accordance with ASME Appendix VIII requirements. This includes probes and ultrasonic instrumentation, procedure variables, and personnel.

The 09-008 and 10-014 weld configurations are represented by a mockup in the EPRI Performance Demonstration Program. The procedure (SI-UT-130) used for these examinations at ANO-2 was qualified through the PDI blind Appendix VIII demonstration process, including probes, instrumentation, and procedure variables; this RCP configuration mockup was successfully demonstrated on as part of that qualification process. Because it is not a requirement of Appendix VIII, Supplement 10, that every test set used for personnel qualification include examples of every weld configuration, it cannot be guaranteed that every individual qualified to SI-UT-130 has demonstrated on this particular RCP configuration mockup.

b. Describe the manner in which these examinations have been performed, such as by a single examiner or by teaming (master/slave, etc.).

The examination crew consisted of a qualified Level II examiner usually being assisted by another qualified Level II examiner. The master/slave approach was not used. The primary examiner performing the scanning observed the ultrasonic device during scanning.

c. State whether a site-specific demonstration was performed as part of the qualification process for the subject examinations. If so, submit the Technical Justification for this site-specific demonstration.

A site-specific demonstration was not performed as part of the qualification process for the subject examinations.

d. The drawings submitted by the licensee are quite useful and show graphical estimates for volumetric coverage. The reduced coverage appears to be primarily associated with circumferential scans (for axially oriented flaws), and indicates that the inner one-third region, where PWSCC would be initially manifested, lacks sufficient volumetric coverage. The licensee's RAI responses dated April 13, 2012, and May 21, 2012, indicate that weld crown concavity (Weld 09-008) and outside diameter weld taper (Weld 10-014) are the specific geometrical causes for limited coverage of these welds. The licensee further suggests that + and −10 degree probe skewing performed increases volumetric coverage, but is not quantified, nor included in the cumulative volumetric coverage obtained. Confirm that the + and -10 degree skew was the result of manually orienting the phased array search unit at these angles, not electronic skews via focal law control.

The skewing as reported on the data sheets of +/- 10 degrees is electronic.

Manual manipulation (skewing) of the search unit is described in the procedure used; however, the extent of such skewing was not identified in the data sheets for 09-008 or 10-014.

4. In order to evaluate the ultrasonic techniques applied and assess whether the examinations performed would be expected to adequately detect PWSCC, the staff is modeling these examinations. In order to make these models accurate, information is needed concerning the as-built geometries of the subject welds and variables associated with the phased array method. Please provide the following information:

a. Phased array probe

iii. Center frequency, bandwidth, pulse excitation type and duration

GEIT Product Code	115-000-566
Center frequency	1.53 mHz
Bandwidth	88%
Pulse excitation type	negative square wave
Pulse duration	@ 20 dB 2.69 E-06
	@ 40 dB 3.54 E-06

ii. Operating mode

1. Transmit-receive (TR), pulse / echo, etc.

Transmit / Receive

2. Longitudinal (L) and/or shear (S) wave

Longitudinal

iii. Array configuration (matrix)

1. Whether identical or different transmit-receive arrays, if used

Identical

2. Physical separation between arrays (if TRL/TRS configuration). Identify distance between first element of one array and first element of second array (array separation – see Figure 1)

[PROPRIETARY]

3. If TRL or TRS mode is used, identify transmit and receive arrays (relative to weld geometry)

Dual Side by Side Arrays are used. When -10° electronic skew is used the transmitter is closest to the weld when +10° electronic skewing is used the receiver is closest to the weld.

iv. Total number of elements per array

1. Number of elements along the primary axis

16

2. Number of elements along the secondary axis

Two transmit and two receive

v. Element dimensions along primary and secondary axes, spacing between elements, and center-to-center distance (pitch – see Figure 2)

Dual 2 x 16 rectangular arrays are used.

1. Element shape if not rectangular

Not applicable. Element shape was rectangular.

vii. Element wiring configuration and element firing/receiving ordering sequence for each array

See transducer specification below. The element firing/receiving ordering sequence for each array is not available; however, the laws were developed Zetec Advanced PA Calculator, Revision 1.0R5 or later revision as allowed.

GE Inspection Technologies
Phase Array Probe Specification

Part Number	115-000-566
Number of Elements	Dual 32
Frequency (MHz)	1.5
Connector	I-Pex
Cable Type	111-160-085 34 conductor Coaxial 50 Ω
Cable Length	8 Ft
Total Crystal Size	1.246" x .274"
Nominal Ceramic Volume %	30%
KT Min (efficiency)	.6
Nominal Ceramic Thickness	.0373"

	[redacted]	
Pitch (16 el)	.078	2.0
Spacing (Kerf)	.002	.05
Element Size (16el axis)	.076	1.95
Pitch (2 el)	.138	3.5
Spacing (Kerf)	.002	.05
Element Size (2el axis)	.136	3.45

vii. Probe manufacturer and/or part number (if available)

GEIT Product Code: 115-000-566

b. Wedge (see Figure 3)

i. Material type – Rexolite, other, etc.

Rexolite

1. Longitudinal and shear wave velocity

Longitudinal velocity of Rexolite is 0.093 in/µsec per material specifications. The default velocity in the Zetec software is 0.0917 in/µsec.

2. Attenuation (if known)

Unknown

3. Density (if known)

Unknown

ii. Geometry

1. Wedge angle

[PROPRIETARY]

2. **Roof angle (if used)**

   [PROPRIETARY]

3. **All physical dimensions necessary to create 3-D solid model, such as height at front of wedge, height at back of wedge, width of wedge, and length of wedge**

   [PROPRIETARY]

4. **Placement of each probe on each wedge; i.e., what is the height of the middle of the first element?**

   [PROPRIETARY]

5. **Is wedge contact geometry contoured to the specimen? If not, what contour does it have, if any?**

   The wedges used for circumferential scanning were flat.

c. Beam focusing

i. Please state the type of focusing used and include associated details, as listed below. The four types of focusing techniques are listed below and shown graphically in Figure 4.

1. *Projection* – focusing in a specific vertical plane

a. Parameters: distance from probe reference point, sweep angles (start, stop, interval), skew angle(s)

Not applicable.

2. *True depth* – focusing at specific constant depth with all angles focused at this depth

a. Parameters: focusing depth, sweep angles (start, stop, interval), skew angle(s)

Not applicable.

3. *Half-path* – sound path held constant as beam is swept

Half-path was used.

a. Parameters: sound path length, sweep angles (start, stop, interval), skew angle(s)

Sound Path length	122 mm
Sweep Angles	Start = 0°, Stop = 80°, Interval = 1°
Skew Angles	+/- 10° electronic skewing

4. *Focal plane* – arbitrary user-defined plane of focus

a. Low angle path length, high angle path length, sweep angles (start, stop, interval), skew angle(s)

Not applicable.

iv. Number and configuration of elements used in data acquisition (active aperture), if different than total number of elements within each probe (e.g., if a linear array probe physically contains 64 elements but only the first 32 were active – this needs to be defined)

Not applicable. All elements were used.

iii. If possible, please provide a set of transmit and receive delay law values for each element at a particular angle and focus to validate model

These are not available. The focal laws were developed using Zetec Advanced PA Calculator, Revision 1.0R5 or later revision as allowed.

d. As-built weld geometry

iii. Provide dimensioned drawings of the welds to be modeled. Are the sketches provided for welds 09-008 and 10-014 (referenced as Figures 2 and 3 in the latest submittal) scaled drawings? Provide angle of OD taper of weld 10-014.

As discussed in the response to RAI 2.a, the scale drawings are provided as Figures 6 and 7 of this submittal.

The angle of the OD taper of weld 10-014 is estimated from the profile data to be up to 17°.

iv. Estimate and provide depth of geometrical anomalies (e.g., concavity or waviness) on the OD surface of the welds that impact volumetric inspection.

This dimension is not available in the examination data.

REFERENCE

1. Westinghouse Calculation Note Number CN-MRCDA-12-27 entitled, "ANO-2 PWSCC Analysis for RCP Dissimilar Metal Welds".

Table 1

Weld Number	Diameter at Pipe	Diameter at Safe End	Thickness of Pipe Near Butter	Thickness on Safe End[1]	Material of Pipe or Elbow	Material of Safe End	Safe End Length Outside Diameter (OD) Toe to Toe
09-008	36.7 inch OD	36.25 inch OD	3.4 inch (measured)	3.125 inch (minimum from drawing)	SA-240 SA-516 Grade 70	SA-351 Grade CF-8M	3.5 inch
10-014	37.0 inch OD	36.2 inch OD	3.95 inch (measured)	3.125 inch (minimum from drawing)	SA-240 SA-516 Grade 70	SA-351 Grade CF-8M	2.3 inch

1. Thickness was not measured on all of the safe ends; however, on those measured, the thickness was typically greater than 3.4 inches.

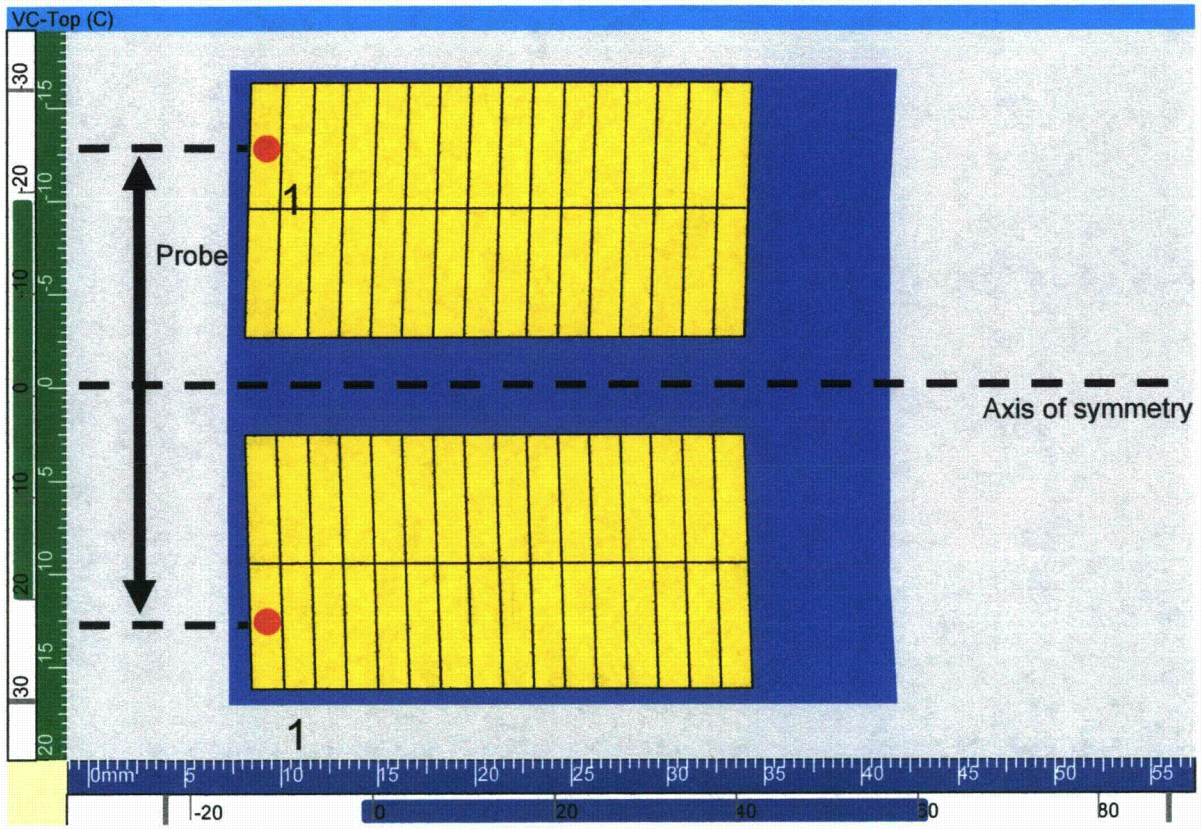


Figure 1 Top View of 2D Matrix Array Depicting Separation Dimension

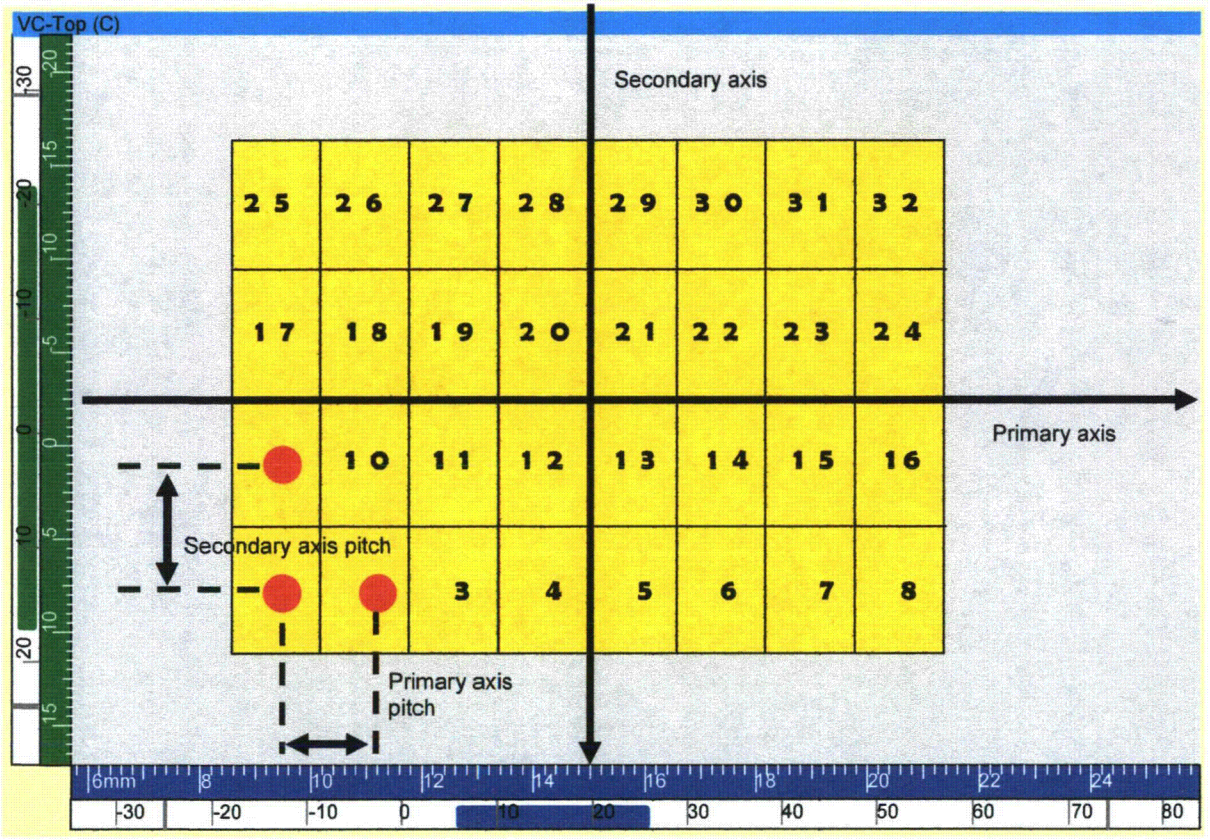


Figure 2 Top View of 2D Matrix Array Depicting Primary and Secondary Axis Pitch Dimensions

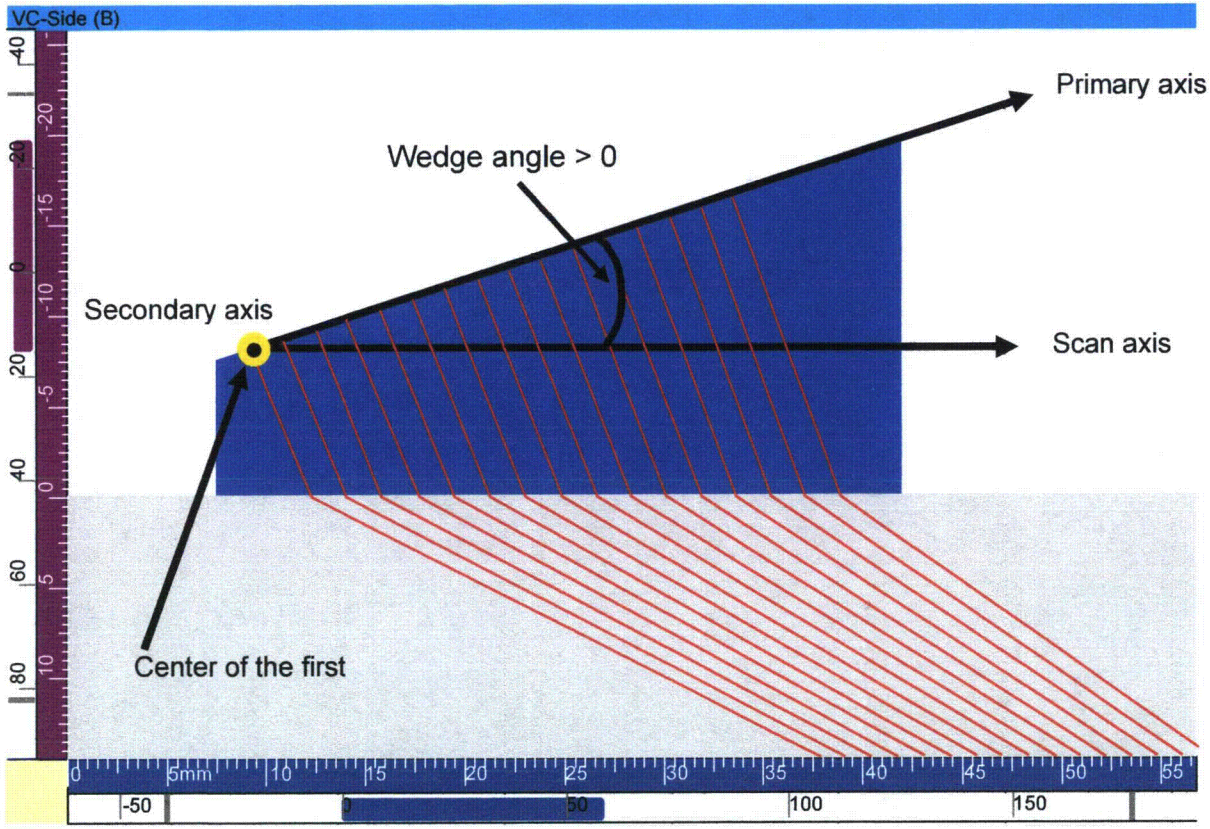


Figure 3 Definition of Wedge Angle

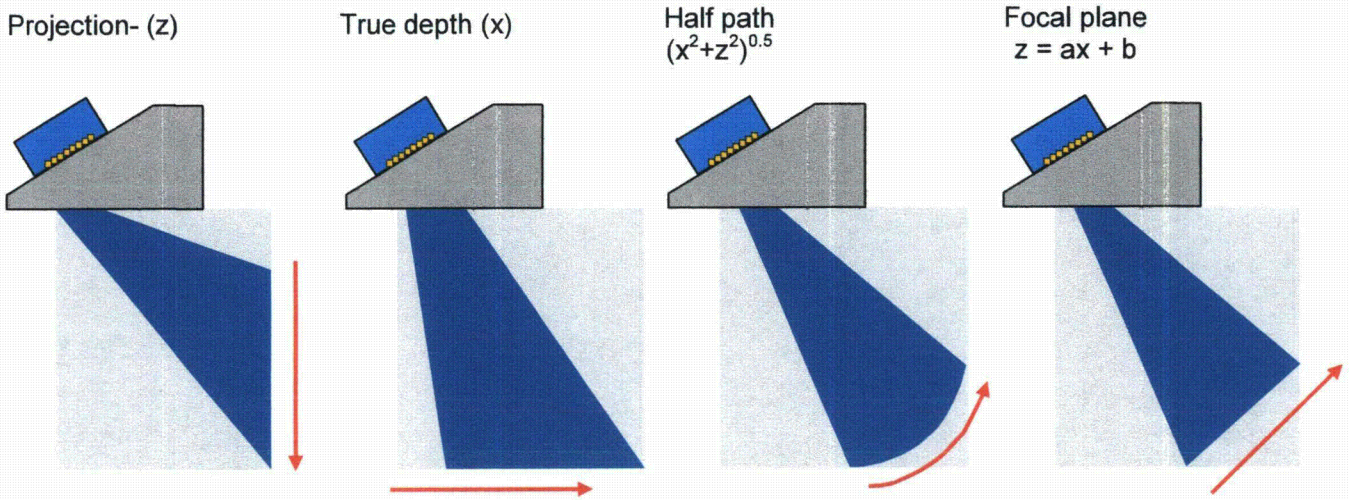


Figure 4 Beam Focusing Options for Phased Array Probes

Figure 6

RCP Suction

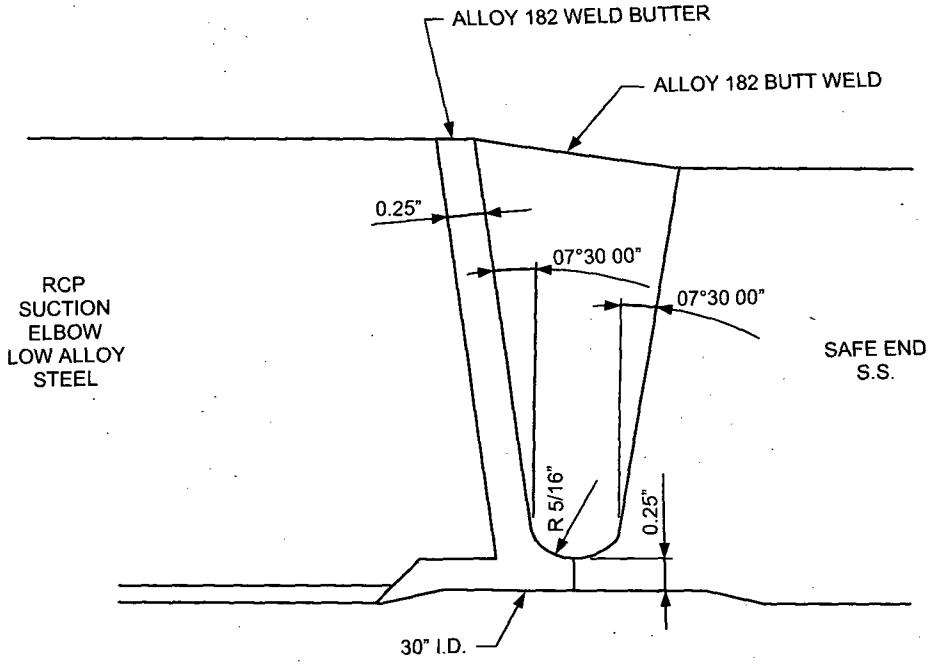


Figure 7

RCP Discharge