WOLF CREEK
NUCLEAR OPERATING CORPORATION

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ET 06-0034

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

Reference: Letter ET 06-0011, dated March 2, 2006, from T. J. Garrett, WCNOC, to USNRC

Subject: Docket 50-482: Wolf Creek Nuclear Operating Corporation's Response to Request for Additional Information Regarding 10 CFR 50.55a Requests I2R-37 and I2R-38

Gentlemen:

The Reference provided Wolf Creek Nuclear Operating Corporation (WCNOC) 10 CFR 50.55a Requests I2R-34, I2R-35, I2R-36, I2R-37, and I2R-38, which requested alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI for inservice inspection and testing for the Second Ten-Year Interval of WCNOC's Inservice Inspection (ISI) Program.

On May 31, 2006, the Nuclear Regulatory Commission (NRC) Project Manager for WCNOC provided by electronic mail a request for additional information (RAI) regarding 10 CFR 50.55a (Relief) Requests I2R-37 and I2R-38.

The Attachment to this letter provides WCNOC's response to the RAI. It lists each NRC question followed by WCNOC's response to each of those questions.

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There are no commitments associated with this submittal. If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Kevin Moles at (620) 364-4126.

Very truly yours,

Terry J. Garrett

TJG/rlt

Attachment: Response to Request for Additional Information Regarding 10 CFR 50.55a Requests I2R-37 and I2R-38

cc: J. N. Donohew (NRC), w/a
W. B. Jones (NRC), w/a
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Senior Resident Inspector (NRC), w/a

Response to Request for Additional Information (RAI) Regarding 10 CFR 50.55a (Relief) Requests I2R-37 and I2R-38

The following are questions on the relief requests (RRs) submitted in the application dated March 2, 2006 (ET 06-0011), followed by the Wolf Creek Nuclear Operating Corporation (WCNOC) response to each question:

1. Questions for RR 12R-37:

(1) Provide and discuss the results of previous ultrasonic testing (UT) inspections performed on the 12 safe-end welds listed in the tables in the RR. Also identify the area of coverage and the type of transducers used in the examinations.

WCNOC Response:

The below table lists the results and area of coverage of the previous UT exams performed on the subject welds at the end Interval 1.

Weld No.	Results	Coverage
RV-302-121-A	NI	100%
RV-302-121-B	NRI	100%
RV-302-121-C	NRI	100%
RV-302-121-D	NI	100%
BB-01-F102	NI	100%
BB-01-F202	NRI	100%
BB-01-F302	NRI	100%
BB-01-F402	NI	100%
BB-01-F103	NI	100%
BB-01-F203	NI	100%
BB-01-F303	NI	100%
BB-01-F403	NI	100%

NI = No indications
NRI = No recordable indications
The following transducers were used in the exams listed in the table above:
0L, 70L, 37L, 45L

It should be noted that the above coverage and results were obtained utilizing a prescriptive based procedure versus the performance based procedure as required by Appendix VIII for the Interval 2 examinations.

(2) Describe the extent and locations of the observed surface irregularities and provide explanation with the assistance of sketches to show that the observed surface irregularities will only affect the detection of axial flaws. Also, discuss what measures you have taken to ensure that the surface condition of the weldment will provide a reliable eddy current examination.

WCNOC Response:

The surface irregularities are located around the inside diameter of the subject welds and are the result of counterbore tapers and/or grinding of the root pass. These surface irregularities do not meet the criteria for smoothness as stated on the Performance Demonstration Qualification Summary (PDQS) for the procedure.

Examination of these welds was performed using a qualified and demonstrated procedure, PDI-ISI-254-SE. During the qualification of this procedure, the detection of axial flaws was limited due to severe irregularities in the inside diameter (ID) contact surfaces of the Performance Demonstration Initiative (PDI) test set. The detection of circumferential flaws met the Appendix VIII criteria on these surfaces with severe irregularities during the PDI performance demonstration. The attached figures 1 and 2 illustrate examples of mapped ID surface irregularities that limited the detection of axial flaws during the qualification of the vendor's procedure, but did not limit the detection of circumferential flaws.

Figure 1

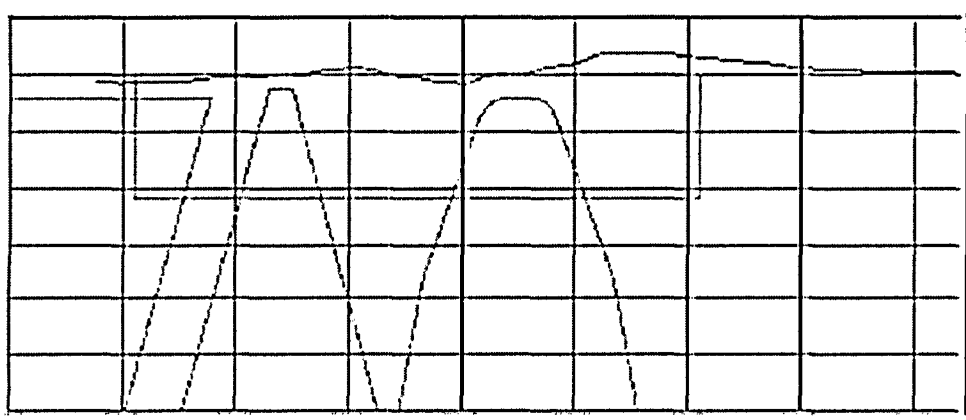
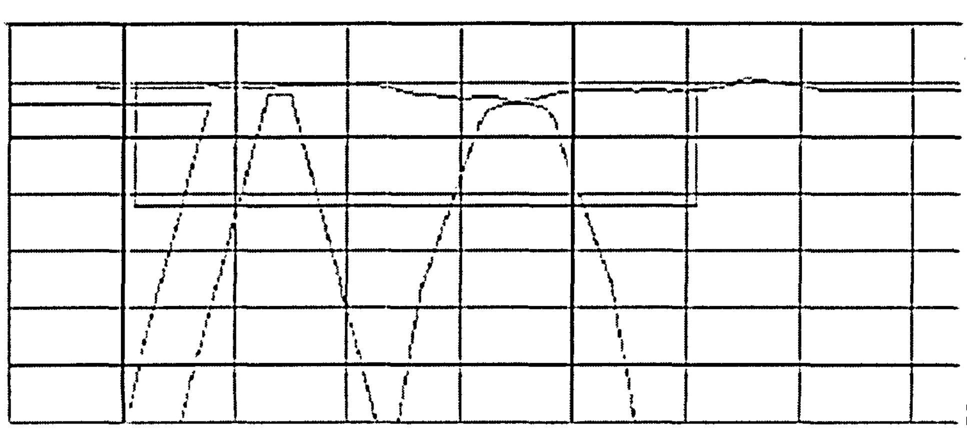


Figure 2



The qualification of the eddy current examination procedure is described in the response to (4) below. The following eddy current techniques were utilized:

1) **Two plus point probes are mounted on the sled which is applied to the pipe inside surface. The plus point probes have a coil size of 0.120" with a footprint of 0.25". Each probe is spring loaded and independently gimbaled to give the best information about surface connected defects in a region of complex geometry. The sled is moved in scan increments of 0.080 inches circumferentially and 0.25 inches axially.**
2) **The systems for data collection and analysis are automated.**

Utilizing this system allowed 100% coverage of the area of interest. Also, the target flaw size for the eddy current procedure is 0.28 inches long, well within the ASME Code linear flaw acceptance standards of 0.45 inches for austenitic material, and 0.625 inches for ferritic material (defined in the Code tables).

In general, for surface breaking flaws, industry experience has proven that the eddy current method provides a very reliable examination. Any service induced cracking in these welds would almost always begin on the ID, thus when the eddy current method is utilized on the ID as described above, it provides a reliable alternative to the UT examination.

(3) For each listed safe-end component, provide the information with a sketch regarding the dimensions of the components and welds, materials, component names and the dimensions of the code required inspection volume.

WCNOC Response:

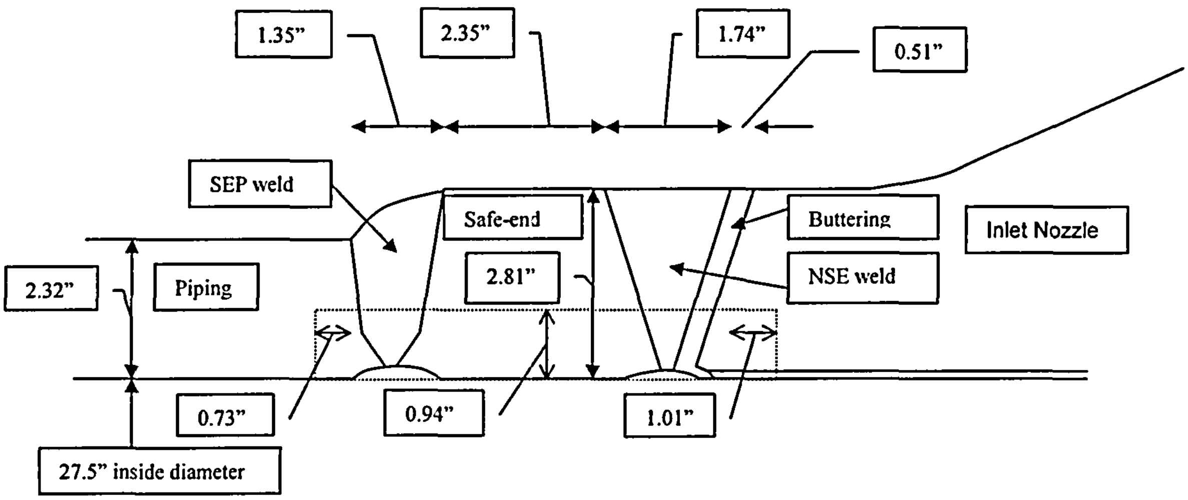
See attached Figures 3 and 4 for dimensions and the table below for the component and weld material.

Component	Nozzle	Butter	NSE weld	Safe-end	SEP weld	Pipe
Material	SA 508 Class 2	Alloy 82/182	Alloy 82/182	SA 182 F 316	308	SA351 CF8A

NSE=Nozzle to safe-end
SEP=Safe-end to piping

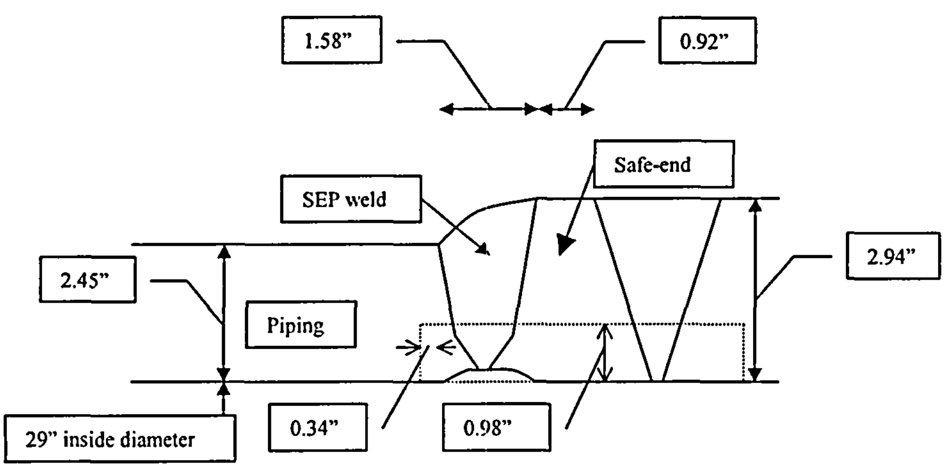
Per Figure IWB-2500-8(c) of ASME Section XI, the volume required to be examined is the inside surface extending up to 1/3 of the thickness of the piping and extending out to ¼" past the edge of the weld crown on each side of the weld. The volume that was actually examined is shown by the dotted line box in the Figures 3 and 4. The figures show that the examined volume extends well beyond that required by the Code. This additional volume was added by the vendor as a "conservative scan factor".

Figure 3
Inlet piping to safe-end and safe-end to inlet nozzle welds



Nozzle to Safe-end (NSE) welds	Safe-end to Pipe (SEP) welds
RV-302-121-A	BB-01-F102
RV-302-121-B	BB-01-F202
RV-302-121-C	BB-01-F302
RV-302-121-D	BB-01-F402

Figure 4
Safe-end to Outlet piping welds



Safe-end to Pipe (SEP) welds
BB-01-F103
BB-01-F203
BB-01-F303
BB-01-F403

(4) Describe how the equipment, procedure and personnel were qualified to perform the eddy current examinations. Was performance demonstration performed on mock-ups of the safe-end welds. Describe also the samples used for equipment/procedure/personnel qualification and the mock-ups for performance demonstration such as the dimensions of the samples/mock-ups and the numbers, size and type of flaws that are imbedded in the samples and mock-ups.

WCNOC Response:

The subject eddy current technique was developed to augment the ultrasonic examination and provide increased sensitivity at the near surface. It was first used in the VC Summer reactor vessel primary nozzle examinations of 2000. The procedure was refined after its first use in 2000 by applying it to the VC Summer hot leg dissimilar metal weld section removed from service. The removed section had a number of primary water stress corrosion cracking flaws along with non-relevant indications resulting from metallurgical interface and surface geometry. Using these actual flaw and geometric conditions in the removed section to refine the technique, the vendor developed a reliable flaw-screening criteria which allowed for the successful use of the procedure in the VC Summer 2002 and 2003 examinations.

Since that time, the technique has been successfully blind tested for the Swedish authority SQC Kvalificeringscentrum AB (SQC NDT Qualification Center) under the program, "Qualification of Equipment, Procedure and Personnel for Detection, Characterization and Sizing of Defects in Areas in Nozzle to Safe End Welds at Ringhals Unit 3 and 4," Hakan Soderstrand 7-10-03. The important qualification parameters for Eddy Current in the SQC blind tests were as follows:
-Defect types: fatigue and stress corrosion cracks
-Tilt: +/-10 degrees; Skew: +/-10 degrees
-Detection target size: IDSCC 6mm (0.25 inches) long
-Flaw location: within 10mm (13/32 inch)
-Length of planar flaw within a 70% confidence level: +/-9mm (3/8 inch)
-False call rate: less than or equal to 20% for the personnel qualification tests
(Ref. SQC Qualification Report No. 019A/03)

The eddy current examination personnel were qualified utilizing the referenced procedures and equipment to Level II or Level III in accordance with a written practice that is in compliance with the applicable requirements of ASNT SNT—TC-1A, CP-189, and ASME Section XI.

(5) Discuss the potential degradation mechanisms that may occur in the safe-end welds that are listed in the tables in the RR. Also discuss the industry-wide service experiences of such welds.

WCNOC Response:

The SS safe end to pipe welds are not susceptible to a degradation mechanism. There have been no failures of these welds in the industry.

Industry experience has shown that dissimilar metal (DM) welds constructed with Alloy 82/182 material may be susceptible to primary water stress corrosion cracking (PWSCC)

as there have been several instances of cracking found in these welds. Thus far all of the locations where cracking has occurred have been at locations exposed to higher temperatures (greater than 565 degrees F). The Wolf Creek Generating Station (WCGS) inlet nozzle to safe end welds (dissimilar metal welds) could be susceptible to PWSCC; however, as the maximum temperature that these welds have seen is 558 degrees F, they are not considered highly susceptible to PWSCC.

(6) Discuss the safety consequences of a failed safe-end component resulting from the growth of the undetected axial flaws.

WCNOC Response:

Axial flaws will not result in guillotine break nor catastrophic failure. Analysis has shown that a detectable leak will develop prior to an axial flaw reaching critical flaw size. Therefore the likelihood of core damage resulting from failure of a component due to an axial flaw is low.

2. Questions for RR 12R-38:

(1) Discuss the results of previous UT inspections performed on the listed piping welds. Also, identify the area of coverage and the type of transducers used in the examinations.

WCNOC Response:

The results, coverage, and transducers for the pre-service (PSI) and Interval 1 examinations are summarized below.

Weld No.	PSI Results	PSI coverage	Interval 1 Results	Interval 1 Coverage
BB-02-FW301	NI	Complete, Note1, 5	NI	Complete, Note1, 8
BG-21-F013B	Note 2	Note 2	Note 2	Note 2
EJ-04-F048A	NRI	Complete, Note1,6	Note 3	Note 3
EP-01-F009	Note 4	Note 4	Note 4	Note 4
EP-01-F021	Note 4	Note 4	Note 4	Note 4
EP-02-F022A	Note 4	Note 4	Note 4	Note 4
BB-02-F001A	NI	Complete, Note1, 7	NI	Complete, Note1, 8
BB-04-F014	NI	Complete, Note1, 7	NI	Complete, Note1, 8

NI = No Indications
NRI = No recordable indications, geometry noted
Note 1) Complete coverage achieved from pipe side only
Note 2) Previously only examined with PT, no UT examination required prior to RI-ISI (risk-informed Inservice Inspection)
Note 3) Class 1, PSI only, Not selected prior to RI-ISI
Note 4) Class 2, No PSI, not selected prior to RI-ISI
Note 5) Transducers used: 0 Longitudinal wave, 0.375", 5.0 Mhz.; 45 Shear wave, 0.25", 2.25 Mhz
Note 6) Transducers used: 0 Longitudinal wave, 0.50", 2.25 Mhz.; 45 Shear wave, 0.50", 2.25 Mhz; 45 Shear wave, 0.25", 2.25 Mhz
Note 7) Transducers used: 0 Longitudinal wave, 0.25", 5.0 Mhz.; 45 Shear wave, 0.25", 2.25 Mhz
Note 8) Transducer used: 45 Shear wave, 0.25", 2.25 Mhz

(2) Provide the following information for each listed piping weld with the assistance of a sketch:
(i) materials, names and dimensions of components and welds, and
(ii) dimensions of the Code required area of examination coverage and the actual area of coverage based on the best effort examination.

WCNOC Response:

Each weld is sketched below in the same order as in the relief request.

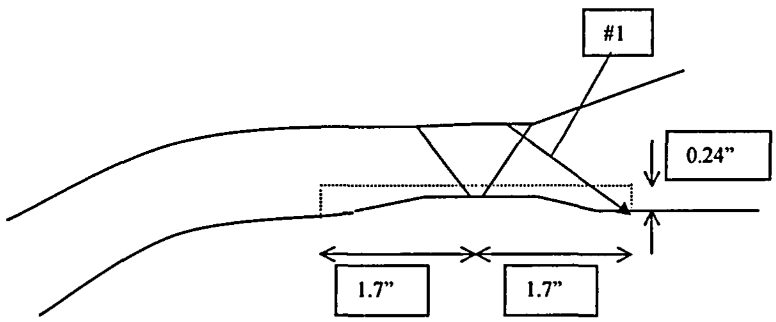
i) Information regarding the material, names and dimensions is provided.

ii) The ASME Section XI required examination area extends to 0.25" on either side of the weld crown. This examination area was covered by the best effort examination on all of the subject welds.
As stated in the relief request, the subject welds are examined in accordance with the methodology utilized in the RI-ISI program. The dimensions of the

required area of examination per the RI-ISI program are shown in the sketch for each weld. The first six welds listed are subject to the thermal fatigue degradation mechanism and the remaining two welds are not subject to a degradation mechanism. For locations subject to potential thermal fatigue degradation, the RI-ISI methodology requires examination of the inner 1/3 thickness to 0.25" on either side of the counterbore for piping of 4" and greater, and examination to 0.5" on either side of the weld crown for piping less than 4". As there is not an examination volume specified for locations with no degradation mechanism, the thermal fatigue required volume is utilized. The amount of best effort coverage of this RI-ISI required examination area is listed for each weld.

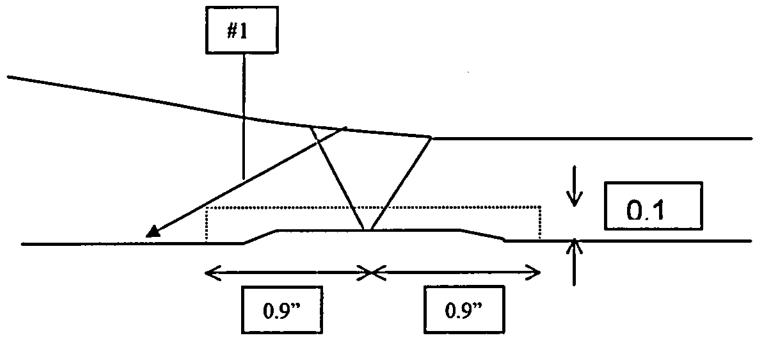
As shown by the statement above, the area required to be examined by the RI-ISI methodology is dependent upon the length of the counterbore. As shown in the following sketches, the counterbore length varies with the individual component. The counterbore length for the valves was taken from valve drawings. The length from the remaining components was taken from the field data.

BB-02-FW301; 6" 180 degree return (SA-312 TP304) to 6" flange (SA-312 TP304) with weld filler material of 308.
Joint size: 6" sch. 160, nominal OD 6.625", nominal thickness 0.719"; counterbore ID 5.325"



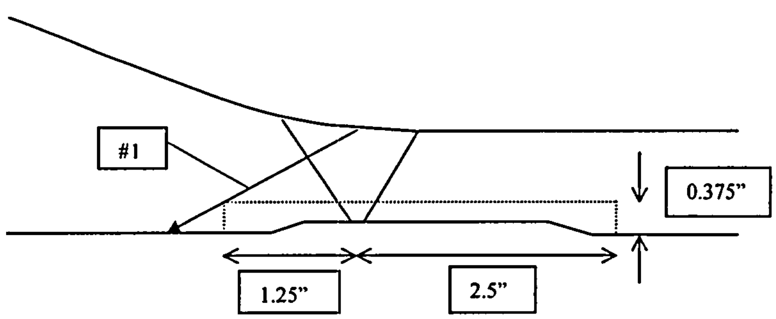
This examination area extends to 0.25" beyond the counterbore as required.
The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 85.2% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 32.4% of the area on the far side of this weld.

BG-21-F013B; 3" Pipe (SA-312 TP304) to Valve 8378A (SA-182 F316) with weld filler material of 308.
Joint size: 3" sch. 160, nominal OD 3.500", nominal thickness 0.438"; counterbore ID 2.692"



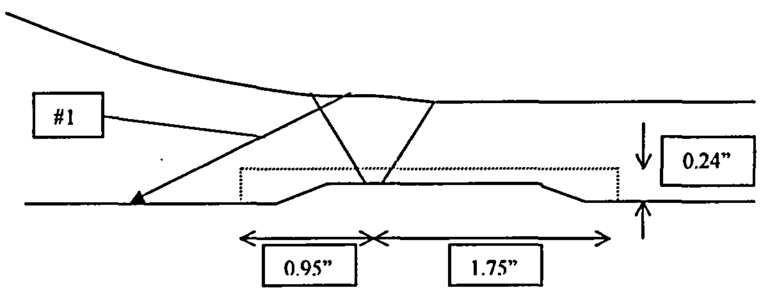
This dimension reflects the RI-ISI requirement of ½" on either side of the weld crown for piping under 4" diameter and is also sufficiently wide to examine 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 70 degree shear wave search unit, is 100% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 44.4% of the area on the far side of this weld.

EJ-04-F048A; 12" Pipe (SA-312 TP304) to Valve HV-8701A (SA-182 F316) with weld filler material of 308.
Joint size: 12" sch. 140, nominal OD 12.75", nominal thickness 1.125"; counterbore ID 10.740"



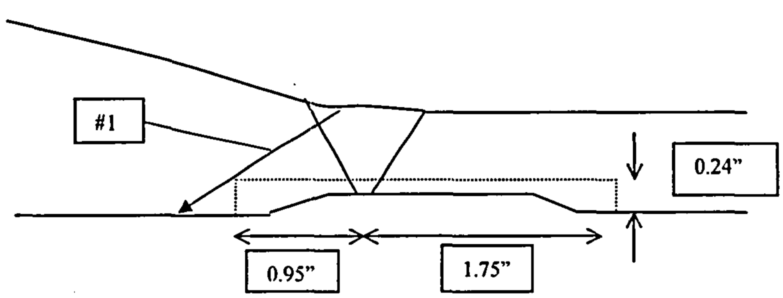
This examination area extends to 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 100% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 60.0% of the area on the far side of this weld.

EP-01-F009; 6" Pipe (SA-312 TP304) to Valve 8818A (SA-182 F304) with weld filler material of 308.
Joint size: 6" sch. 160, nominal OD 6.625", nominal thickness 0.719"; counterbore ID 5.325"



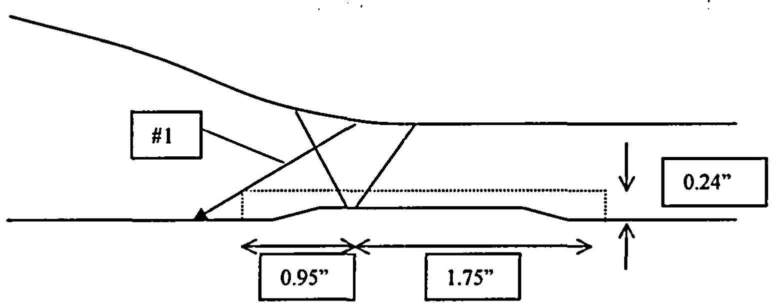
This examination area extends to 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 100% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 65.3% of the area on the far side of this weld.

EP-01-F021; 6" Pipe (SA-312 TP304) to Valve 8818D (SA-182 F304) with weld filler material of 308.
Joint size: 6" sch. 160, nominal OD 6.625", nominal thickness 0.719"; counterbore ID 5.325"



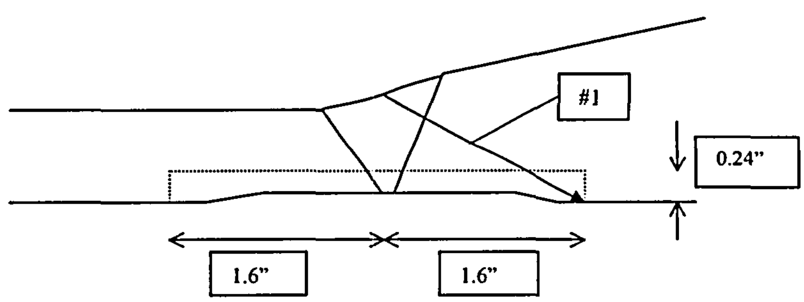
This examination area extends to 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 100% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 42.1% of the area on the far side of this weld.

EP-02-F022A; 6" Pipe (SA-312 TP304) to Valve 8818C (SA-182 F304) with weld filler material of 308.
Joint size: 6" sch. 160, nominal OD 6.625", nominal thickness 0.719"; counterbore ID 5.325"



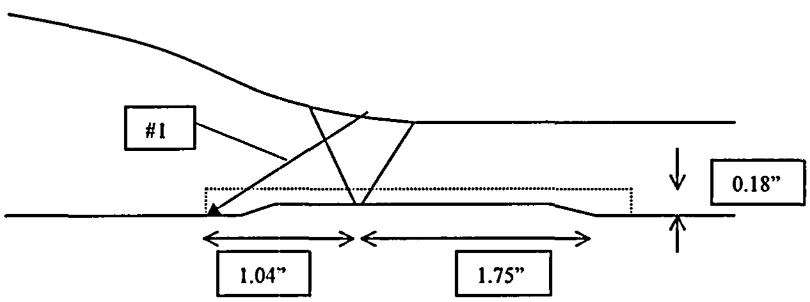
This examination area extends to 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 100% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 52.6% of the area on the far side of this weld.

BB-02-F001A; 6" Pipe (SA-312 TP304) to Pressurizer Safety Nozzle Safe-End (SA-182 F316L) with weld filler material of 308.
Joint size: 6" sch. 160, nominal OD 6.625", nominal thickness 0.719"; counterbore ID 5.325"



This examination area extends to 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 87.0% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 38.8% of the area on the far side of this weld.

BB-04-F014; Valve PCV-455C (SA-182 F316L) to 4" Pipe (SA-312 TP304) with weld filler material of 308.
Joint size: 4" sch. 160, nominal OD 4.500", nominal thickness 0.531"; counterbore ID 3.529"



This examination area extends to 0.25" beyond the counterbore. The amount of axial coverage obtained by the best effort examination, utilizing the supplemental 60 degree longitudinal wave search unit, is 85.0% of the area on the far side of the weld. Arrow #1 in the diagram above depicts the extent of the best effort examination perpendicular to the weld. The best effort parallel scan was conducted to the extent possible from the weld crown. This scan examined 20.0% of the area on the far side of this weld.

(3) Discuss the potential degradation mechanisms that may occur in the piping welds that are listed in the table. Discuss also the (1) most likely crack initiation locations resulting from each potential degradation mechanism and (2) industry-wide service experiences of such welds.

WCNOC Response:

Thermal fatigue is the degradation mechanism that has potential to occur in the first six welds. The last two welds are not susceptible to a degradation mechanism. Industry inspection and operating experience have shown that the counterbore transition region on the pipe side (the thinner component) is the most likely crack initiation location to result from thermal fatigue degradation mechanism due to stress concentration concerns. There is sufficient evidence to assure that dominate cracking will occur in the pipe side of the joint.

(4) Based on the best effort examination of the far side of the component welds, provide the following information:

(i) Describe the best effort one-sided examination including Identifying the area of coverage at each listed weld and provide a discussion of the adequacy in detecting the axial and circumferential flaws at the far side of the weld.

WCNOC Response:

The area of coverage is described and sketched in the response to (2) above. The best effort circumferential scans (searching for axial flaws) are conducted across the weld crown. For axial scans (searching for circumferential flaws), direction is provided in the PDI procedure for use of supplemental search units to examine the far side of the weld.

These best effort examinations are performed using the best available techniques from the accessible surface. While these techniques are capable of detecting flaws on the far side of the welds, they do not meet the qualification requirements of Appendix VIII.

(ii) Describe your effort in improving the area of coverage at the far-side of the weld such as grinding the weld crown, examining from the tapered surface and the employment of advanced technique such as using the phased array transducers.

WCNOC Response:

For the locations specified in this relief, the weld crowns and tapers are installed, ground and blended to meet the Construction Code requirements. Further grinding would gain little, if any, increase in coverage.

The examination from the tapered surface is performed to the extent possible on a best effort basis.

There is not currently any automated or phased array procedure for austenitic weld examination that is fully qualified for these single sided examinations. All of the automated procedures listed on the PDI web site have a limitation when used for single sided access exams with the PDQS usually stating: "The austenitic single side qualifications, documented on this summary, demonstrate application of best available technology, but do not meet the requirements of 10CFR 50.55a(b)(2)(xvi)(B)." See discussion in iii below for future examination improvement plans.

(iii) Describe your plan in developing a better examination of the listed piping welds to improve the coverage of the far-side of the weld.

WCNOC Response:

WCNOC is actively addressing these technical issues via several strategies:

- **Participation in the Materials Reliability Program, which in turn has engaged the EPRI NDE Center**
- **Participation in ASME Section XI Code activities, which develops the rules for examination of these welds.**
- **Participation in the EPRI NDE Product Group Steering Committee to develop research of new or improved technologies to allow for better examination of these types of welds.**
- **Participation in the Performance Demonstration Initiative to evaluate and qualify new technology to used in these applications.**
- **Partnering with vendor and utility personnel to evaluate new technology to improve coverage of these welds.**

WCNOC will employ the best technology and methods available to assure that maximum coverage of these types of welds is obtained.

Reference:

1. EPRI TR-112657 Rev. B-A; Revised Risk-Informed Inservice Inspection Evaluation Procedure