

RECIRCULATION SYSTEM WELDS - SEPTEMBER 1984 OUTAGE

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INTRODUCTION

The James A. FitzPatrick Nuclear Power Plant was shut down on September 15, 1984 for the purpose of performing maintenance and modification activities including an Induction Heat Stress Improvement (IHSI) of 84 welds in the Recirculating Water and RHR System.

Personnel from Ebasco and KWU/UTL, as well as from NYPA, performed Ultrasonic Testing (UT) for the purpose of detecting IGSCC. These examinations consisted of performing a pre-IHSI examination on most weldments either during this outage or during previous 1983 and 1984 outages and also performing a post-IHSI U.T. examination on all weldments treated during this outage. The UT procedures, calibration standards, equipment, and IGSCC detection capabilities were satisfactorily demonstrated in accordance with I&E Bulletin 83-02, and the same procedures and techniques were used in the UT examination. All UT personnel conducting these inspections have received appropriate training in IGSCC inspection.

The indications were found by Ebasco personnel using 45° and 60° angles of shear waves at 2-1/4 MHz. The sizing was performed by KWU/UTL using various techniques including:

- ID mode conversion - creeping wave
- SLIC 40-dual element multiple angle
- 45°, 4 MHz
- 60°, 4 MHz
- SUSI, dual element focused beam
- crack tip diffraction, 45°, 4 MHz
- head wave, creeping wave on ID

The results of the examinations indicated that a total of 11 welds showed reportable indications. The detailed evaluation of the results is presented in the section entitled, "Ultrasonic Examination."

Structural Integrity performed flow evaluations on the defective welds to determine whether overlay repair is needed or not. Five defective welds required weld overlay. Structural Integrity also performed weld overlay design. Region I of the NRC has confirmed that the weld overlay repairs were performed in accordance with the qualified and approved procedures consistent with industry and ASME Code requirements.

In summary, during the current scheduled FitzPatrick outage, a total of 84 welds were ultrasonically examined and treated with IHSI. The UT results indicated that 11 welds showed crack indications. Of these, 5 welds were overlay repaired. The remaining 6 cracks were evaluated and found to meet acceptance criteria delineated in Generic Letter 84-11 for operation until the upcoming refueling outage.

ULTRASONIC EXAMINATION

An Ultrasonic Examination for the purpose of detecting IGSCC was performed on all weldments subject to IHSI treatment. This examination consisted of performing a pre-IHSI examination on most weldments either during this outage or during previous 1983 and 1984 outages and also performing a post-IHSI U.T. examination on all weldments treated during this outage.

The Ultrasonic Examination consisted of three phases; they are U.T. Detection, UT Discrimination, and UT Flaw Sizing. All personnel and procedures utilized in performing these examinations were qualified in accordance with I&E Bulletin 83-02 for detection and flaw sizing, as applicable.

The detection examinations were performed primarily by personnel from Ebasco Services, Incorporated. For the detection of IGSCC, Ebasco used equipment and personnel demonstrated to be qualified in accordance with the EPRI NDE Center Course, "UT Operator Training for the Detection of IGSCC." This detection consisted of establishment of the weldment ID & OD profile (see Attachment 1 for details). Performing a manual 45° angle beam examination from both sides, when applicable, and when possible. All pipe-to-pipe, and pipe-to-elbow configurations were scanned on both sides. All pipe-to-pump, pipe-to-valve, and pipe-to-tee configurations were completed on the pipe side only. The heavy sections of the fitting and necessary weld taper preclude any examinations in these areas. No relevant ultrasonic information is available on the component side of the weld because ultrasonic examinations of the component side of the weld joint is not possible. However, the component side of the weld joint is usually fabricated from IGSCC resistant material such as cast stainless steel. The specific examination restrictions were summarized on the attached Examination Summary Sheets. When a 45° angle beam examination was not possible due to excess weld crowns or ID weld contour (see Attachment 2), the weldment was examined by a 60° angle beam transducer. The 60° angle beam was also utilized by Ebasco in addition to the 45° examination when additional information was desired in discriminating U.T. signals (see attachment 3 for further details on Ebasco U.T. techniques). Ebasco provided results of all U.T. examinations to the NYPA Level III Examiner. The NYPA Level III Examiner, upon review of the Ebasco data and performance of any additional, informational U.T. examinations, would direct the UTL/KWU examiners to perform additional discrimination and flaw sizing (see Attachment 4 for details of NYPA Level III involvement).

The additional discrimination and flaw sizing was performed primarily by personnel from KWU. The flaw sizing of IGSCC was performed both manually and semi-automatically (Robby) by examiners that passed the EPRI NDE Center Course, "UT Operator Training for Planar Flaw Sizing." The discrimination and flaw sizing consisted of the detection of areas which were identified by Ebasco (through the NYPA Level III) where signals were obtained which are suspicious for crack indications. Techniques used by KWU WSY 70° and 45° shear wave are highly sensitive to corner like reflectors. KWU would next determine the position at which the assumed crack should be deepest by a rough crack depth estimation (using correlated echo No. 1 and/or amplitude functions). KWU then measures the OD/ID profile (see Attachment 5 for details). Consideration for detectability and discrimination of cracks/geometry are done using the OD/ID profile.

ULTRASONIC EXAMINATION (Cont.)

Based on conclusions drawn above, further detection techniques (for example 60° shear wave) were used where the inspection of geometry does not allow a complete coverage of the area which has to be examined. To discriminate between cracks and geometry, KWU performed further techniques when necessary, such as 70° longitudinal probes to detect the possibility of cracks on the top of the counterbore. In the cases where the discrimination results indicate a crack, the crack depth was determined by detecting crack ferrites and the crack tip. All available techniques were used. Upon completion of discrimination and flaw sizing, all data is presented to the NYPA UT Level III for final review and acceptance.

Final KWU flaw sizing data, including manual plots, are then presented to Structural Integrity Associates through the NYPA Site Responsible Engineer for performance of flaw evaluation.

FLAW EVALUATION

The post-IHSI ultrasonic examinations performed both in March and September, 1984 revealed eleven (11) indications considered to be IGSCC. Structural Integrity Associates (SIA) performed a flaw evaluation for each indication. Their evaluations indicated that five (5) of the defective welds required weld overlay repairs and that six (6) were acceptable for continued operation without repair.

The reported crack depths in the six (6) unrepaired defective welds were shallow, ranging from less than 5% to 17% of wall thickness. The crack lengths reported for these indications were less than 5% of the total circumference in all six welds.

The evaluations for these flaws determined the crack growth of each flaw in both the as-welded and post-IHSI stress state. The time period for each crack to reach the allowable end-of-cycle flaw size in terms of allowable flaw depth versus length as detailed in ASME Section XI, Article IWB-3840 was determined. This limit is further reduced by one-third in accordance with Generic Letter 84-11 and then used to determine the period of operation without repair. Using the as-welded case, and not taking any credit for the successful application of IHSI performed on these joints, the worst case crack growth occurs in weld 12-17. It is calculated that this crack would exceed 2/3 of the IWB-3840 limit in 5.5 months, which is in excess of the time until the next refuel outage.

However, when the post-IHSI residual stress state is considered in the crack growth calculations, no future growth for any of these flaws over the remaining plant life. This conclusion holds true even when considerable errors are included for uncertainties in crack depth sizing. Also included in these evaluations, for conservatism, are the influence of thermal stresses to account for the possible effects of low toughness weldment material.

Based on these evaluations, it is believed that continued operation with these unrepaired flaws until the next refueling outage, in a worst case, and for the remaining plant life, if the benefits of IHSI are included, would not reduce the piping design margins and not lead to a reduction in plant safety.

WELD OVERLAYS

Structural Integrity Associates also provided the overlay designs for the five welds that required overlay repairs. The welds have indications of cracking with depths ranging from 45% to 100% of wall (three of the five had through leaks). Four of these welds were riser pipe to safe-end and had cracks that ran intermittently around 360° of the circumference. The pipe-to-elbow cracking had a length of 12.5% of the circumference.

The overlays were designed to meet the requirements for full structural strength and load transfer from the cracked piping. The overlay design thicknesses do not take credit for the first dye penetrant test acceptable weld layer. This additional conservatism was added to reduce the significance of any uncertainties in ultrasonic sizing of IGSCC indications.

All layers were made with stainless steel weld metal with a maximum carbon content of 0.020% and each layer had a minimum ferrite content equivalent to 10 FN. All overlay designs took no credit for the effect of prior performance of IHSI, nor for the development of compressive residual stresses by the overlay welding itself, on future crack propagation. All overlays exhibit an "as-built" thickness after the first (dye penetrant acceptable) layer which is greater than the design requirements. The final as-built lengths also meet or exceed the design requirements. Additionally, the welding was performed using a relatively low heat input (≤ 40 KJ/in) to minimize additional sensitization of the underlying adjacent piping material while developing a compressive residual stress pattern. These benefits were not considered in the overlay design and add further conservatisms to ensure no propagation of the observed IGSCC into the weld overlay.

Examination of Weld Overlays

A thickness check utilizing ultrasonic (UT) was performed on the pipe prior to any welding being performed. A Liquid Penetrant (PT) exam was also performed on the pipe prior to the 1st pass. After the 1st pass was completed, a PT and a visual (VT) exam was performed. If satisfactory, a ferrite check was made to ensure ferrite content between 10_N - 20_N and another UT thickness was taken. Successive passes were then performed to bring the cladding up to the required overlay design thickness and width criteria with visual exams and ferrite content checks performed after each pass. On the final pass, a VT, PT, UT thickness check, and ferrite content exam was performed. If satisfactory, a lack-of-bond exam was performed using U.T. techniques (4 automatic & 1 manual). If any automatic exams showed any indication of loss of back wall reflection, these areas were re-examined utilizing manual techniques.

The results of these lack-of-bond exams are as follows:

- 12-02-2-70 - Sat. (Manual)
- 12-02-2-69 - Sat. (Auto.)
- 12-02-2-64 - Sat. (Auto.)
- 12-02-2-23 - Sat. (Auto.)

WELD OVERLAYS (Cont.)

12-02-2-12 - 1 small area (.125" x .8") made up of four (4) small, rounded indications believed to be porosity indications in the seal weld placed manually over the cracked area prior to clad overlay. (This seal weld was performed using fast-freezing material, E-308L-16.)

Finally, the weld overlay integrity was verified by a 100% operating pressure test of the recirculation system during which a visual examination for leakage was performed. No evidence of leakage was observed.

METHOD OF DETERMINING EBASCO WELD ID & OD PROFILE

The O.D. profile is taken by use of a weld profile needle gauge. This ID profile is formulated through a combination of various sources of information; the main source being a thorough 0° examination taken at various points around the weld. This exam is performed by scanning across the weld from base metal across weld material to base metal while observing the screen. Notations are made during this scan; ie: counterbore and root locations, variances in thickness, abnormalities, etc. This information is then compared to the baseline radiographs and an accurate I.D. profile is assembled.

DESCRIPTION OF EBASCO DETECTION METHODS

The detection methods employed by Ebasco personnel include the following steps:

- A) Generally a nominal 45° shear wave examination was used as the primary detection angle.
- B) The calibration for this technique is performed using the 3/4T side drilled hole for sensitivity and establishing metal path.
- C) The primary area of interest is marked on the screen between the 3/8 node and the 5/8 node for quick reference of reflectors.
- D) If there are any recordable reflectors detected in the primary area of interest that whose source can not be readily identified by the inspector, ID and OD profiles of the weld are constructed. This is done by using a contour gauge on the weld and adjacent base material at the locations that the reflectors are noted. It is then necessary to do a 0° longitudinal examination for precise thickness readings in these areas. A weld profile is then drawn from these measurements.
- E) Once the profile has been established, the surface distances and metal path measurements taken during the angle beam examinations are included in the drawing to graphically display the locations of the reflectors.
- F) A detailed analysis of the weld plots are then made by the level III and if it is determined that additional data is required for final analysis, supplemental examinations are performed.
- G) If additional data is required, a 60° angle beam examination is implemented using a senior technician and following the same parameters and techniques as the 45° examination. A second review is then performed comparing both sets of results for consistency, placement and through wall dimensioning.
- H) These reports are then forwarded to the NYPA for review and further analysis.

A. Smith Level III
ISI Coordinator/QA Specialist

NYPA LEVEL III U.T. EXAMINER INVOLVEMENT

The NYPA Level III oversaw the entire operation of NDE involved in the testing for the IHSI and overlay programs. This included performing surveillances upon arrival on site for both Ebasco and KWU/UTL personnel, equipment and materials. In addition, constant surveillance in the field enabled the NYPA Level III to remain aware of the status of the examinations being performed.

The NYPA Level III aided Ebasco in detection by furnishing details derived from baseline radiographs and archive files of previous exams. He also accompanied Ebasco personnel into the drywell to observe indications and to apply other techniques (O.D. creeping wave and crack tip diffraction for example) to aid in determining the nature of the reflectors.

He also assigned portions of weld exams to KWU/UTL personnel for further discrimination and sizing as deemed necessary. These examinations were also observed by the NYPA Level III when time allowed.

The NYPA Level III performed further analysis of confirmed cracks by obtaining more information regarding length and thru-wall dimensioning on some welds so as to be able to construct a 'B' scan-type plot to assist in assembling an overall view of what the condition actually appeared to be.

KWU STEP BY STEP PROCEDURE FOR ESTABLISHING THE ID/OD WELD PROFILE

1. Examination of the region of interest for determination of the ID/OD weld profile is measured.
 - a) A rough crack depth estimation using:
 - * WSY probe considering correlated echo No. 1 which is sensitive only for crack depths greater than 10%.
 - * 45° shear wave probe, amplitude based on the assumption that deep cracks have a larger extended opening.
2. Measurement of the OD is accomplished with the use of a contour gauge.
3. Then the O.D. weld profile is transferred to the Contour Inspection Sheet.
4. The root centerline is determined by using a straight beam probe (longitudinal) and marking the position on the weld and on the contour inspection sheet.
5. Measurements on the weld crown and adjacent parent material on each side of the weld are taken and recorded.
6. Evaluation of the ID profile is based upon the measured data. Special consideration should be given for the gap between the probe shoe and the OD. The change of sound velocity in the weld material and the directivity pattern of the probe used.

KWJ GENERAL INSPECTION CRITERIA FOR
DETECTION, DISCRIMINATION AND SIZING

1st Step

Detection of areas where signals were obtained which are suspicions for crack indications. The used techniques WSY 70° and 45° shear wave are highly sensitive to corner like reflectors. For example, used sensitivity for riser welds: 0.1 mm/0.004" WSY 70 and 0.4 mm/0.016" 45° shear wave probe. See examples of typical amplitude functions.

2nd Step

Determination of the position at which the assumed crack should be deepest by a rough crack depth estimation, by using correlated echo No. 1 and/or amplitude function.

3rd Step

Measurement of the OD/ID profile.

4th Step

Consideration for detectability and discrimination of cracks/geometry were done using the OD/ID profile.

5th Step

By the conclusions of Step 4, further detection techniques (for example 60° shear wave probe) were used where the inspection of geometry does not allow a complete coverage of the area which has to be examined.

6th Step

To discriminate between geometry and cracks, further techniques should be used as far as it is necessary. Example: Counterbore indications with a machined groove should be re-inspected using 70° longitudinal probe to detect cracks on the top of the counterbore.

ATTACHMENT 6 (Cont.)

7th Step

In case that the discrimination results in a cracked pipe, the crack depth will be determined by detecting crack facettes and the crack tip. All available techniques should be used to the extent that the results are confirmed. The choice of the transducers depends on the ID/OD profile and the sound attenuation. These techniques include the sizing methods of EPRI.

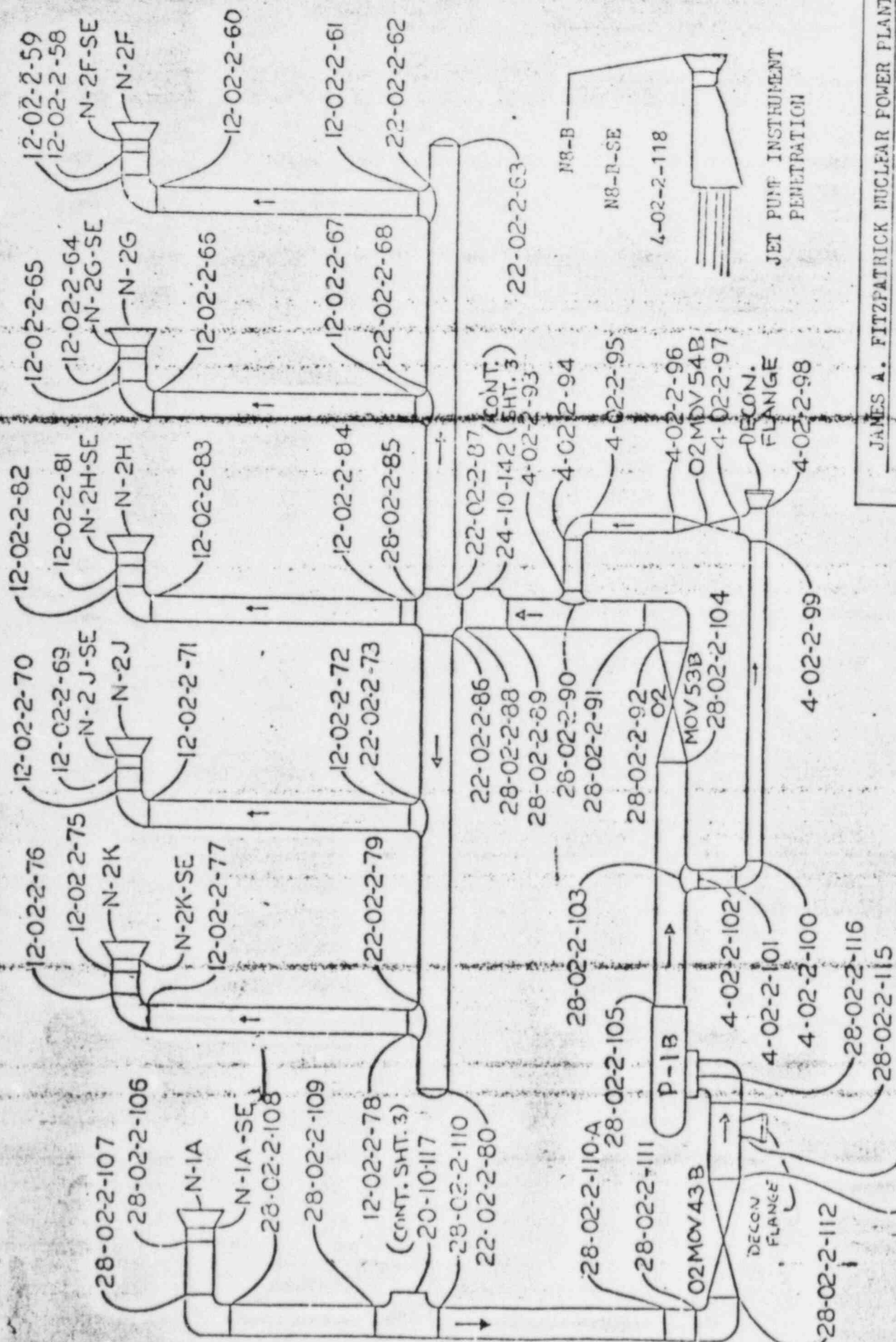
EXPLANATION OF NYPA COMPUTER PLOTS

On 360° weld plots how was the plot assembled and how were areas not measured and unflawed areas plotted? The weld is scanned 360° (100% of weld).

Measurements are taken in one inch (1") increments. If an abrupt change in the indication or geometry occurs between the 1" increments, it is recorded between these one inch increments. If no recorded abrupt change occurred, then the computer will extrapolate the information between the two recorded one inch (1") pts and average values are assigned in 1/4" increments. The computer plots were validated by comparison with hand plots developed by the NYPA Level III and found to be correct in detail.

How do you interpret the plots if there was an obstruction? If this question is regarding a physical obstruction (none were noted as all physical obstructions were removed), the computer plotting technique would not be utilized but rather a hand plot reflecting actual conditions (e.g., skewered angle, opposite side of weld, etc.) would be incorporated into the plotting technique.

The computer plots provided to the NRC with the U.T. data packages (See JAFP-84-0979) were informational only. They provide an additional graphic representation of the crack profile and were not utilized as a means for flaw evaluation.



NOTES

1. AUGMENTED INSP REQ.
ON ALL WELDS

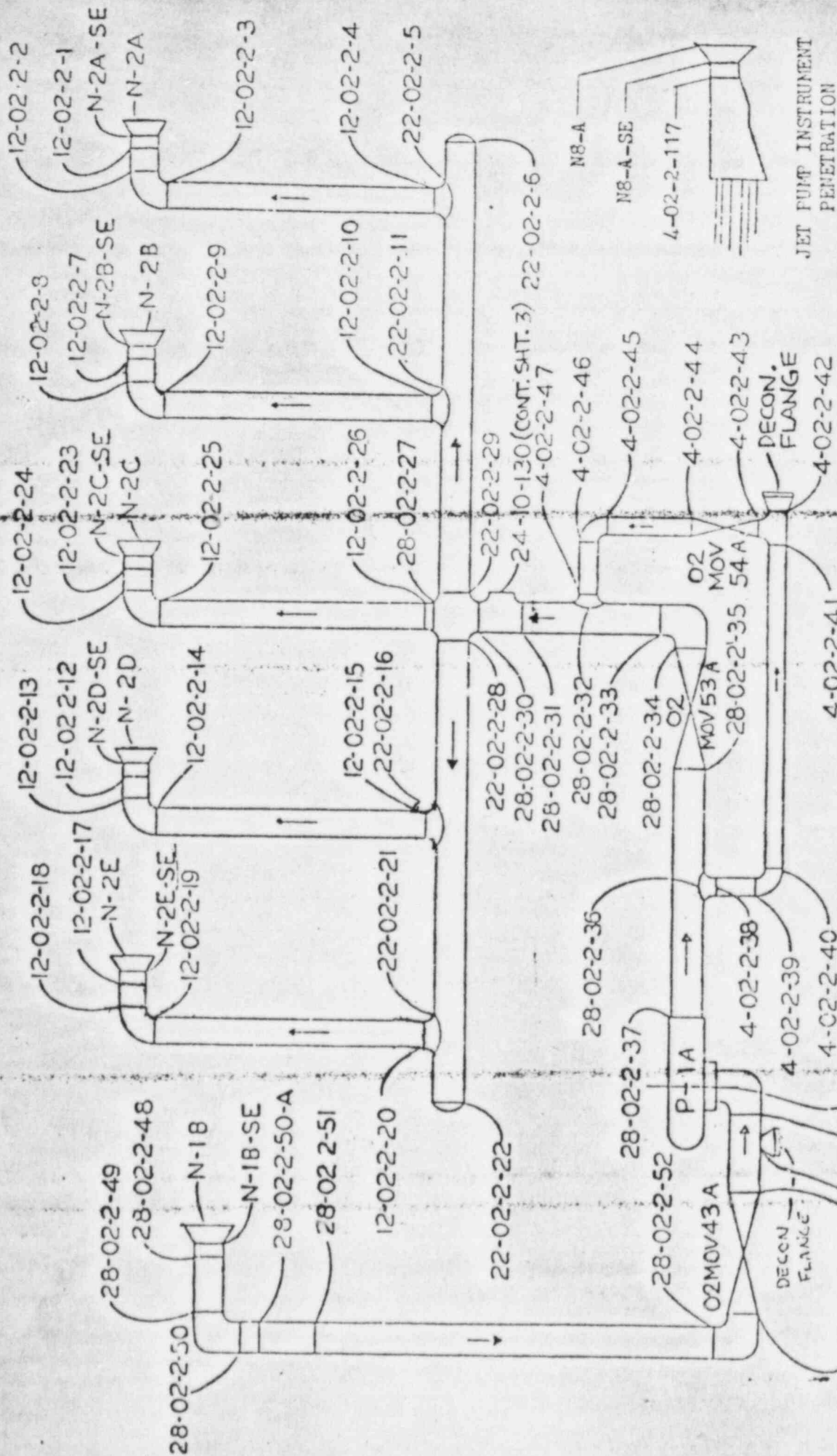
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

REGULATION SYSTEM

WELD	LOCATION	IDENTIFICATION
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ISRU-2

Rev 33



JAMES A. FITZPATRICK NUCLEAR POWER PLANT
RECIRCULATION SYSTEM
WELD LOCATION IDENTIFICATION
ISI-J-1

1. REFER TO STONE & WEBSTER
DRAWING NO. 11825-FP-87A
FOR ADDITIONAL INFORMATION
2. AUGMENTED INSTR. REQ.
ON ALL WELDS

WELD SUMMARY

TABLE 1

JAMES A. FITZPATRICK - RESULTS OF IGSCC INSPECTIONS

Weld No.	Loop	Weld Location	Crack Type	Length	Thru Wall	Depth Var.	IHSI	Discovery Method	Previous Inspection	Corrective Action	Remarks
12-4	A	Pipe to sweep-o-let	C	1.0%	No	7.5%	Yes	UT-Pre & Post IHSI 9/84	6/83	IHSI & Analysis	
12-12	A	Pipe to safe end	C	100%	Yes 1	Avg.50% Max.100% Min.<5%	Yes	PT,Visual, UT,Post IHSI 9/84		Weld Overlay	See Note 1
12-17	A	Pipe to safe end	C	4.0% 3.0%	No	Max.10%	Yes	UT,Post IHSI 9/84	12/81	None	Indications 90% apart
12-23	A	Pipe to safe end	C	100% int.	No	Avg.40% Max.75% Min.<5%	Yes	UT,Post IHSI 9/84	6/83	Weld Overlay	See Note 1
12-64	B	Pipe to safe end	C	100% int.	Yes 2	Avg.30% Max.100% Min.<5%	Yes	PT,Visual, UT,Post IHSI 9/84		Weld Overlay	See Note 1
12-69	B	Pipe to safe end	C	100%	Yes 2	Not aplt	Yes	PT,Visual UT,post IHSI 9/84	12/81	Weld Overlay	See Note 1
12-70	B	Elbow to pipe	C	12.6%	No	45%	Yes	UT,Pre-IHSI 9/84	12/81	Weld Overlay	
28-48	A	Pipe to safe end	C	1.1%	No	15%	Yes	UT,Pre-IHSI 3/84		IHSI & Analysis	
28-53	A	Elbcw to valve	C	.3%	No	5%	Yes	UT,Pre-IHSI 9/84	6/83	IHSI & Analysis	
28-112	B	Elbow to valve	C	.6%	No	17%	Yes	UT,Pre-IHSI 9/84	6/83	IHSI & Analysis	
28-113	B	Valve to pipe	C	.5%	No	10%	Yes	UT,Pre-IHSI 9/84	6/83	IHSI & Analysis	

Note 1 - No pre-IHSI UT examination performed.

TABLE 2

WELD NUMBER	EXAMINED BY:			IHSI RELATIONSHIP		E B A S C O							RESULTS
				PRE IHSI	POST IHSI	EXAM ANGLE			EXTENT OF EXAM				
	EBASCO	KWU	NYPA			0°	45°	60°	CIRC.	SIDE		REASON	
										ONE	TWO		
12-1	X			N/A	N/A	X	X		360°		X		N/A
12-2	X			N/A	N/A	X	X		360°		X		N/A
12-3	X			N/A	N/A	X		X	360°		X	60° transducer used due to weld crown	Root Geo 360° Intermit.
12-4	X			N/A	N/A	X	X		360°	X		Sweep-o-let (Partial Exam)	" " " "
12-5	X			N/A	N/A	X	X		360°	X		Sweep-o-let (partial exam)	N/A
12-7	X			N/A	N/A	X	X		360°		X		Root Geo 360° Intermit.
12-8	X			N/A	N/A	X	X		360°		X		
12-9	X			N/A	N/A	X		X	360°		X	60° transducer used due to weld crown	Root Geo 360° Intermit.
12-10	X			N/A	N/A	X	X		360°		X		Root Geo 360° Intermit.
12-23	X			N/A	N/A	X	X		360°		X		" " " "
12-24	X			N/A	N/A	X	X		360°		X		" " " "
12-25	X			N/A	N/A	X		X	360°		X	60° transducer used due to weld crown	" " " "
12-26	X			N/A	N/A	X	X		360°		X		N/A
12-75	X			N/A	N/A	X	X		360°		X		Root Geo 360° Intermit.
12-76	X			N/A	N/A	X	X		360°		X		Root Geo 360° Intermit.

NOTE: N/A = No recordable indications.

WELD NUMBER	EXAMINED BY:		IHSI RELATIONSHIP				E B A S C O						RESULTS
	EBASCO	KWU	PRE IHSI	POST IHSI	EXAM ANGLE		CIRC.	SIDE		REASON			
					0°	45°		60°	ONE		TWO		
12-77	X		N/A	N/A	X		X			X	60° Transducer used due to weld crown	Root Geo 360° Intermit	
12-78	X		N/A	N/A	X	X		360°	X		Sweep-o-let Partial	" " " (L.A.)	
12-80	X		N/A	N/A	X	X		360°		X		Laminar Indication Root Geo 360° Intermit	
22-6	X		N/A	N/A	X	X		360°		X		N/A	
22-11	X		N/A	N/A	X	X		360°	X		Sweep-o-let	N/A	
22-22	X		N/A	N/A	X	X		360°		X		1.9" L - 20%	
22-28	X		N/A	N/A	X	X		360°		X		N/A	
22-29	X		N/A	N/A	X	X		360°		X		Root Geo 360° Intermit	
22-63	X		N/A	N/A	X	X		360°		X		N/A	
22-79	X		N/A	N/A	X	X		360°	X		End Cap Laminar Indication	N/A	
22-86	X		N/A	N/A	X	X		360°	X		Sweep-o-let Partial	N/A	
22-27	X		N/A	N/A	X	X		360°	X		Partial Exam due to tee configuration	Root Geo 360° Intermit	
28-27	X		N/A	N/A	X	X		360°	X		Partial exam due to tee configuration	Root Geo 360° Intermit	
28-31	X		N/A	N/A	X	X		360°	X		Partial exam due to reducer interference	N/A	
28-32	X		N/A	N/A	X	X		360°	X		Partial exam due to tee interference	N/A	
28-33	X		N/A	N/A	X	X		360°		X		N/A	
			N/A	N/A	X	X		360°		X		N/A	

[illegible]

TABLE 3

[illegible]

TABLE 5

[illegible]

TABLE 6

WELD NUMBER	EXAMINED BY:			IHSI RELATIONSHIP		E B A S C O								RESULTS
						EXAM ANGLE			EXTENT OF EXAM					
	EBASCO	KWU	NYPA	PRE IHSI	POST IHSI	0°	45°	60°	CIRC.	SIDE		REASON		
										ONE	TWO			
12-01	X			N/A	X		X	1 X	X	2 X		1. Excess concaved weld toe limits 45° exam. 2. Safe-end on downstream side	Turned over to NYPA/KWU for further evaluation	
12-02	X			N/A	X			1 X	X		X	1. Excessive weld crown limits 45° exam	Turned over to NYPA/KWU for further evaluation	
12-03	X			X	X			X	X		X	N/A	No indications. Acceptable	
12-04	X			N/A	X		X	X	X	1 X		1. Pipe side scan due to pipe to saddle geometry	Turned over to NYPA/KWU for further evaluation	
12-07	X			N/A	X			1 X	X	2 X		1. Excessive concavity at weld toe limits 45° exam. 2. Safe end on downstream side	Turned over to NYPA/KWU for further evaluation	
12-09	X			X	X			1 X	X		X	1. Excessive weld crown limits 45° exam	No indications. Acceptable	
12-12	X			N/A	X			1 X	X	2 X		1. Excess concave at weld toe limits 45° exam. 2. Safe-end on downstream side.	Turned over to NYPA/KWU for further evaluation	
12-13	X			X	X			1 X	X		X	1. Excessive weld crown limits 45° exam	No indications. Acceptable	
12-14	X			X	X			1 X	X		X	1. Excessive weld crown limits 45° exam	No indications. Acceptable	
12-17	X			N/A	X			1 X	X	2 X		1. Excess concave at weld tow limits 45° exam. 2. Safe-end on downstream side	Turned over to NYPA/KWU for further evaluation	
12-19	X			X	X			1 X	X		X	1. Excessive weld crown limits 45° weld exam.	No indications. Acceptable	
12-23	X			N/A	X		X	1 X	X	2 X		1. Excess concave at toe limits 45° exam 2. Safe-end on downstream side	Turned over to NYPA/KWU for further evaluation	
12-10	X			N/A	X		X		X	1 X		1. One side due to saddle geometry	No indications. Acceptable	
12-24	X			N/A	X			1 X	X		X	1. Excessive weld crown limits 45° weld exam	No indications. Acceptable	
12-25	X			N/A	X			1 X	X		X	1. Excessive weld crown limits 45° weld exam	No indications. Acceptable	
12-26	X			N/A	X		X		X	1 X		1. Pipe side exam due to reducer geometry	No indications. Acceptable	

12"

WELD NUMBER	EXAMINED BY:			IHSI RELATIONSHIP		E B A S C O							RESULTS	
						EXAM ANGLE			EXTENT OF EXAM					
	EBASCO	KWU	NYPA	PRE IHSI	POST IHSI	0°	45°	60°	CIRC.	SIDE		REASON		
										ONE	TWO			
12-58	X			N/A	X			1 X	X	X			1. Excess concavity at weld toe limits 45° exam. 2. Safe end on downstream side	Mult.non-record.ind's in B.M.360° Int.to NYPA Accept.
12-59	X			N/A	X			1 X	X		X		1. Excess wide weld crown limits 45° exam	Turned over to NYPA/KWU for further evaluation
12-60	X			X	X			1 X	X		X		1. Excess wide weld crown limits 45° exam	I.D. Geometry 360° Int. Acceptable
12-61	X			X	X		X	X	X	1 X			1. Exam from pipe side due to saddle geometry	Turned over to NYPA/KWU for further evaluation
12-64	X			N/A	X			1 X	X	2 X			1. Excess concave at weld toe limits 45° exam. 2. Safe end on downstream side	Turned over to NYPA/KWU for further evaluation
12-65	X			X	X	X		1 X	X		X		1. Excess wide weld crown limits 45° exam	Turned over to NYPA/KWU for further evaluation
12-66	X			X	X			1 X					1. Excess wide weld crown limits 45° exam	No indications Acceptable
12-67	X			X	X		X		X	X			Scan from pipe side due to saddle geom.	No indications Acceptable
12-69	X			N/A	X			1 X	X	2 X			1. Excess concavity at weld toe limits 45° exam. 2. Safe end on downstream side	Turned over to NYPA/KWU for further evaluation
12-70	X			N/A	X			1 X	X		X		1. Excess wide weld crown limits 45° exam	Turned over to NYPA/KWU for further evaluation
12-71	X			N/A	X			1 X	X		X		1. Excess wide weld crown limits 45° exam	Root geometry Acceptable
12-72	X			X	X		X		X	1 X			1. Scan from pipe side due to saddle geometry	Low-level non-recordable indications;acceptable
12-75	X			N/A	X			1 X	X	2 X			1. Excess concavity at weld toe limits 45° exam. 2. Safe end on downstream side	Turned over to NYPA/KWU for further evaluation
12-76	X			N/A	X		X	1 X	X		X		1. Performed for further evaluation of indications	Turned over to NYPA/KWU for further evaluation
12-77	X			N/A	X			1 X	X		X		1. Excess wide weld crown limits 45° scan	Turned over to NYPA/KWU for further evaluation
12-78	X			X	X		X		X	1 X			1. Scan from pipe side due to saddle geometry.	No indications Acceptable

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28"

WELD NUMBER	EXAMINED BY:			IRSI RELATIONSHIP		ERASCO							RESULTS
				PRE IRSI	POST IRSI	EXAM ANGLE			EXTENT OF EXAM				
	ERASCO	KWU	NYPA			0°	45°	60°	CIRC.	SIDE		REASON	
										ONE	TWO		
28-27	X			X	X	X	N/A	N/A	N/A	N/A	N/A	0° Exam due to geometry of base metal taper	No indications. Acceptable
28-30	X			X	X	X	N/A	N/A	N/A	N/A	N/A	0° exam due to geometry of base metal taper	No indications. Acceptable
28-31	X			X	X		X		X		X	N/A	No indications. Acceptable
28-32	X			N/A	X		X		X	X		4" Sockolet to 28" pipe, geo. allows effective scan from 28" side only	I.D. Geometry 360° Int. Acceptable
28-33	X			N/A	X		X		X		X	N/A	No indications. Acceptable
28-34	X			X	X		X	X	X	X	1	1. Elbow scan only due to valve geometry	Low-level non-recordable ind. geometry; acceptable
28-35	X			X	X		X		X	X	1	1. Tee side scan due to valve geometry	No indications. Acceptable
28-36	X			X	X		X		X	X	1	1. 4" Sockolet to 28" pipe, geometry allows effective scan from 28" side only	I.D. Geometry 360° Int. Acceptable
28-37	X			X	X		X			X	1	1. Scan from tee only due to pump geometry	Low-amp non-recordable signals, acceptable
28-50A	X			X	X		X		X		X	N/A	No indications. Acceptable
28-51	X			X	X		X		X		X	N/A	No indications. Acceptable
28-52	X			X	X		X		X		X	N/A	Low-level non-recordable indication; Acceptable
28-53	X			X	X		X	X	X	X	1	1. Scan from elbow only due to valve geometry	Turned over to NYPA/KWU for further evaluation
28-54	X			X	X		X		X	X	1	1. Scan from pipe only due to valve geometry	Root geometry Acceptable
28-55	X			X	X		X		X	X	1	1. 4" sockolet to 28" pipe, geo. only allows effective scan from 28" side only	No indications. Acceptable
28-56	X				X		X	X	X		X	N/A	Turned over to NYPA/KWU for further evaluation

28"

WELD NUMBER	EXAMINED BY:			IRSI RELATIONSHIP		E B A S C O							RESULTS
				PRE IRSI	POST IRSI	EXAM ANGLE			EXTENT OF EXAM				
	EBASCO	KWU	NYPA			0°	45°	60°	CIRC.	SIDE		REASON	
										ONE	TWO		
28-57	X			X	X		X	X	X	X		1. Elbow scan only due to pump geometry	Turned over to NYPA/KWU for further evaluation
28-85	X			N/A	X	X			N/A	N/A	N/A	0° scan only due to base metal geometry and taper	No indications. Acceptable
28-88	X			X	X	X			N/A	N/A	N/A	0° scan only due to base metal geometry and taper	No indications. Acceptable
28-89	X			X	X		X		X		X	N/A	No indications. Acceptable
28-90	X			N/A	X		X		X	X		1. 4" sockolet to 28" pipe, scanned 28" side only due to geometry	No indications. Acceptable
28-91	X			X	X		X		X		X	N/A	No indications. Acceptable
28-92	X			X	X		X	X	X	X		1. Scanned from elbow side due to valve geometry	Turned over to NYPA/KWU for further evaluation
28-103	X			X	X		X		X	X		1. 4" sockolet to 28" pipe scanned 20" side only due to geometry	Turned over to NYPA/KWU for further evaluation
28-104	X			X	X		X		X	X		1. Scan from pipe side only due to valve geometry	No indications. Acceptable
28-105	X			X	X		X		X	X		1. Scanned from pipe side due to pump geometry	No indications. Acceptable
28-109	X			X	X		X		X	X		1. Scanned from pipe side only due to tee geometry	Root geometry Acceptable
28-110	X			X	X		X	X	X	X		1. Scanned from pipe side only due to tee geometry	Turned over to NYPA/KWU for further evaluation
28-110	X			X	X		X		X		X	N/A	No indications. Acceptable
28-111	X			X	X		X		X		X	N/A	No indications. Acceptable
28-112	X			N/A	X		X	X	X	X		1. Scan from elbow side due to valve geometry	Turned over to NYPA/KWU for further evaluation
28-113	X			N/A	X		X	X	X	X		1. Scanned from pipe side only due to valve geometry	Turned over to NYPA/KWU for further evaluation

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WELD NUMBER	IHSI RELATIONSHIP		KWU EXAM ANGLE						KWU EXTENT OF EXAM		KWU RESULTS
	PRE	POST	45°	60°	WSY	RTD	SUS	SLIC 40	DEG		
12-1		X	X	X	X	X	X			Pipe side only 33" - 0 - .5" CW	ID - Geometry
12-2		X	X	X	X					2" - 7" CW	Geometry
12-4		X	X	X	X				MWB 70°	Pipe side only 6" - 12" CW	◀ 7.5% thru wall crack
12-7		X	X	X	X					Pipe side only 32" - 0 - 1.5" CW	ID - Geometry
12-17		X	X	X	X					Pipe side only 8" - 14.5" CW	◀ 10% thru-wall-crack
12-23		X		X	X	X				Pipe side only 38" - 0 - 8" CW	75% thru-wall crack
12-61	X	X	X	X	X					Pipe side only 9" - 17" CW	ID - Geometry
12-65		X	X	X	X					0" - 4" CW	No recordable indications
12-69		X			X					Pipe side only 360°	360° intermittent cracking
12-75		X	X	X	X					Pipe side only 8.5" - 18.5" CW	Geometry
12-76		X	X	X	X					360°	Geometry
12-77	X		X	X	X					11" - 13" CW	No recordable indications
12-81		X	X	X	X	X			X	Pipe side only 9" - 13" CW	Geometry
12-59	X		X	X	X					33" - 38" CCW	Geometry
12-70		X	X	X	X	X		MWB 70	X	7.5" - 12.5 CW	45% thru-wall crack

RTD: High Angle Longitudinal Creeping Wave (OD)

SUS: High Damped 52° Shear Wave

SLIC 40: Shear-and-longitudinal-mode interpretation and calculation prove (angle summary approx. 40°)

WSY: 30-70-70 shear-and-longitudinal probe with ID - creeping wave.

WELD NUMBER	IHSI RELATIONSHIP		KWU EXAM ANGLE						KWU EXTENT OF EXAM	KWU RESULTS
	PRE	POST	45°	60°	WSY	RTD	SUS	SLIC 40	DEG	
20-117	X		X	X	X				Elbow side only 5.5" - 14.5" CW	No recordable indicaitons
28-53	X	X	X	X	X				Elbow side only 27" - 29" CCW	< 5%
28-56		X	X	X	X				1.5" - 5.5" CCW	Geometry
28-57	X	X	X	X	X		X		Elbow side only 13" - 17" CCW	< 5%
28-92	X		X		X	X	X	X	14"-22" CW Elbow Side Only 14"-22" CCW	Geometry
28-103	X		X	X	X		X		Pipe side only 5" - 10" CW	No recordable indications
28-110	X		X	X	X				Pipe side only 17.5" - 25.5" CW	< 5%
28-112		X	X	X	X		X		Elbow side only 5" - 12" CW	17% thru-wall crack
28-113		X	X	X	X				Pipe side only 5" - 9" CW	10% thru-wall crack

RTD: High Angle Longitudinal Creeping Wave (OD)

SUS: High Damped 52° Shear Wave

SLIC 40: Shear-and-longitudinal-mode interpretation and calculation probe (angle summary approx. 40°)

WSY: 30-70-70 Shear and longitudinal probe with ID - creeping wave

WELD NUMBER	IHSI RELATIONSHIP		NYPA EXAM ANGLE						NYPA EXTENT OF EXAM DEG	NYPA RESULTS
	PRE	POST	0°	45°	60°	70°				
12-12		X		X		X	O.D.	Creeping	360° Pipe side only	360° Int. - one thru-wall
12-17		X		X		X	O.D.	Creeping	360° Pipe side only	two small ($\leq 10\%$) Ind.
12-58		X		X		X	O.D.	Creeping	360° Pipe side only	geometric reflectors
12-61	X	X		X	X	X	O.D.	Creeping	360° Pipe side only	geometric reflectors
12-64		X		X		X	O.D.	Creeping	360° Pipe side only	360° Int. - two thru-wall
12-75		X		X		X	O.D.	Creeping	360° Pipe side only	geometric reflectors
12-81		X		X		X	O.D.	Creeping	360° Pipe side only	geometric reflectors

NOTE: Pipe side only exams performed on pipe to safe end welds. Safe end examinations not required for IGSCC detection. Weld 12-61 performed on pipe side only because no relevant information is available on component side of weld because ultrasonic examination of the component side of weld joint is not possible.