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SORENSEN,G.C. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Provides response to questions asked by licensee in 910510 ltr re rept on flaw in reactor recirculation piping.Drawing ref refers to drawings included w/Ref 2.

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	NRR/DET/ESGB	1	1	NRR/DOEA/OTSB11	1	1
	NRR/DST 8E2	1	1	NRR/DST/SELB 8D	1	1
	NRR/DST/SICB8H3	1	1	NRR/DST/SRXB 8E	1	1
	NUDOCS-ABSTRACT	1	1	OC/LFMB	1	0
	OGC/HDS1	1	0	REG FILE 01	1	1
	RES/DSIR/EIB	1	1			
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R I D S / A D D S

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352

May 15, 1991
G02-91-098

Docket No. 50-397

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

Gentlemen:

Subject: **NUCLEAR PLANT NO. 2, OPERATING LICENSE NPF-21 REPORT ON FLAW IN REACTOR RECIRCULATION PIPING, ADDITIONAL INFORMATION (TAC NO. 80358)**

References:
1) Letter, G02-91-096, G.C. Sorensen (SS) to NRC, same subject, dated May 10, 1991

2) Letter, G02-89-123, G. C. Sorensen (SS) to NRC, "Supply System's Response to Generic letter 88-01 Request for Additional Information", dated July 20, 1989

The following is provided in response to questions asked by the Staff of the Reference 1 submittal.

1. **Water Chemistry History** - The history of the WNP-2 water chemistry is provided in Attachment 2.

2. **UT Characterization of 20RRC(6)-8 Indication** - The characterization of this indication is provided in Attachment 3.

3. **Input to Flaw Evaluation** - This is provided in Attachment 4.

4. **Post-IHSI Examination** - IHSI was performed on this weld but it was not post IHSI UT examined because the IHSI was done on this weld prior to service.

5. **Location of 20RRC(6)-8** - The location of this weld is shown on Figure RRC-105 of Reference 2.

A001
1/1

6. WNP-2 R6 Flaw Evaluation Summary - The summary provided in Reference 1 has been revised to define the code allowable crack depth of 0.62 inches based upon the welding process used for this weld. The revised summary is included as Attachment 1. Page 3 of this attachment discusses the need for the revision in more detail.

7. Sample Expansion - Three circumferential welds were scheduled to be examined during R6. As a result of the indication found on 20RRC(6)-8 the examination was expanded by an additional three circumferential welds of the same category (Category B).

Weld	Drawing
20RHR(2)-1	RHR-104
20RHR(2)-2	RHR-104
12RRC(7)B-1	RRC-107

The drawing reference refers to the drawings included with Reference 2.

Very truly yours,

G. C. Sorensen, Manager
Regulatory Programs

AGH/bk
Attachments

cc: JB Martin - NRC RV
NS Reynolds - Winston & Strawn
PL Eng - NRC
DL Williams - BPA/399
NRC Site Inspector - 901A

Attachment 1

WNP-2 R6 FLAW EVALUATION SUMMARY (Rev. 1)

INTRODUCTION

A fracture mechanics evaluation was performed to evaluate a linear indication found during in-service inspection of ISI weld number 20 RRC (6)-8. This particular weld consists of a SA-358 GR. 304 stainless steel pipe welded to a valve manufactured from SA-351 CF8M stainless steel. The indication was found on the upstream side of valve RHR-V-113. The defect is located in the 304 base metal at the top of the pipe centered at the 0° location (twelve o'clock position). The defect was sized at 0.15 inches deep and 4.5 inches long. The size of the defect exceeds the 1986 ASME Code Section XI Table IWB 3514-2 allowable and thus requires evaluation per paragraph IWB 3640 of the Code. The following discussion provides a comprehensive summary of the fracture mechanics model, applied loads (stresses), and Code evaluations that were performed.

METHODOLOGY

Stress (Loads) Evaluation

The stress state at the location of the flaw is required to determine the driving force for crack propagation. Stresses for the applicable loading conditions were extracted from the ASME Class 1 Stress Report for the subject RHR piping (Calculation No. 8.14.107) to complete the RHR piping flaw evaluation.

The following load combinations were evaluated to determine if the crack would grow under the imposed loads. Two of the evaluations (fatigue and intergranular stress corrosion cracking (IGSCC)) encompass the requirements of IWB-3640. The third evaluation was done to evaluate the flaw growth under the relatively short duration applied load caused by the worst thermal transient experienced by the system, i.e. plant shutdown.

> The imposed load for fatigue evaluation consists of superimposing the pressure, deadweight bending, normal operating thermal bending stress and the weld residual stress to complete the evaluation of the minimum fracture stress intensity. Pressure, deadweight bending, and thermal bending stresses are conservatively combined with the worst case faulted dynamic bending stresses (without regard to the direction of the applied stress) to complete the evaluation of the maximum fracture stress intensity range. This methodology conservatively includes faulted dynamic stresses in the normal/upset evaluation and conservatively adds additional thermal stresses into the faulted evaluation. The number of dynamic loading cycles is based on the design basis main steam safety relief valve actuations which yield approximately 300 stress cycles per year. The peak

dynamic loading includes 300 cycles of the Safe Shutdown Earthquake event even though the plant design basis is 10 stress cycles.

The IGSCC evaluation was completed using the steady state deadweight pressure and bending stress and the normal plant operation thermal stress.

The thermal transient load evaluation superimposed the pressure and deadweight bending stresses on the thermal bending and thermal gradient stresses. The dynamic stress was not included due to the low probability of occurrence during the short duration of the peak thermal gradient stress.

In each loading condition the above stress states were then superimposed on the weld residual stress distribution to complete the respective flaw evaluations. The resulting flaw sizes were then evaluated against the end of evaluation period depth-to-thickness ratios from Tables IWB-3641-5 and IWB-3641-6.

Flaw Evaluation

The indication was evaluated using the NASCRAC computer code developed by Failure Analysis Associates. This code uses stress field influence functions as the basis for flaw propagation. The NASCRAC model selected is a shell element containing an elliptically shaped circumferential flaw. The model is identified as 703 in the NASCRAC manual. This particular model includes three crack growth degrees of freedom encompassing the respective circumferential and crack depth coordinates. The evaluation was performed using conservative linear elastic fracture mechanics principles.

The modeling applies the requirements identified in NRC Generic Letter 88-01. The flaw was evaluated as an intergranular stress corrosion crack using the crack growth rate equation provided in the generic letter. The weld residual stress distribution provided in the letter was also used even though the weld in question had induction heat stress improvement (IHSI) performed on it in 1983. The weld residual stresses are developed from room temperature yield for 304 material (30 ksi) as the normalization stress outlined in the generic letter. The flaw aspect ratio was reviewed and compared to the requirements of NUREG-0313, Rev. 2. The aspect ratio was determined to be 30:1 which exceeds the NRC requirements for maintaining the same aspect ratio during crack growth. Therefore the final crack growth aspect ratio was determined by the NASCRAC flaw model.

In performing the evaluation the flaw model was run to evaluate fatigue damage for a one year operating cycle. The crack was evaluated using both a da/dn curve for BWR water environments and an air environment for austenitic stainless steel. The da/dn equation used for BWR environments was provided in the EPRI report NP-4690-SR "Evaluation of Flaws in Austenitic Piping " dated July 1986, page 3-2, Equation 3-1. In this EPRI equation the E-factor selected for a BWR environment was taken as ten. The curve used for the air environment is that provided in ASME Code Section XI, Appendix C, Figure C-3210-1 for an R-ratio of 0.79.

Upon completion of the fatigue evaluation the NASCRAC flaw model was executed to complete the IGSCC evaluation. The crack dimensions for the evaluation period as determined by fatigue would normally be used as input for the initial crack dimensions for the IGSCC model. However the growth due to the 300 fatigue cycles did not yield a significant change in the initial crack size. Therefore the original flaw size was used as the input for the IGSCC model. The equation used for the IGSCC crack growth rate, as mentioned earlier, was that provided in the generic letter.

The above described flaw evaluation and computer outputs are documented in Supply System calculation ME-02-91-30.

CONCLUSION

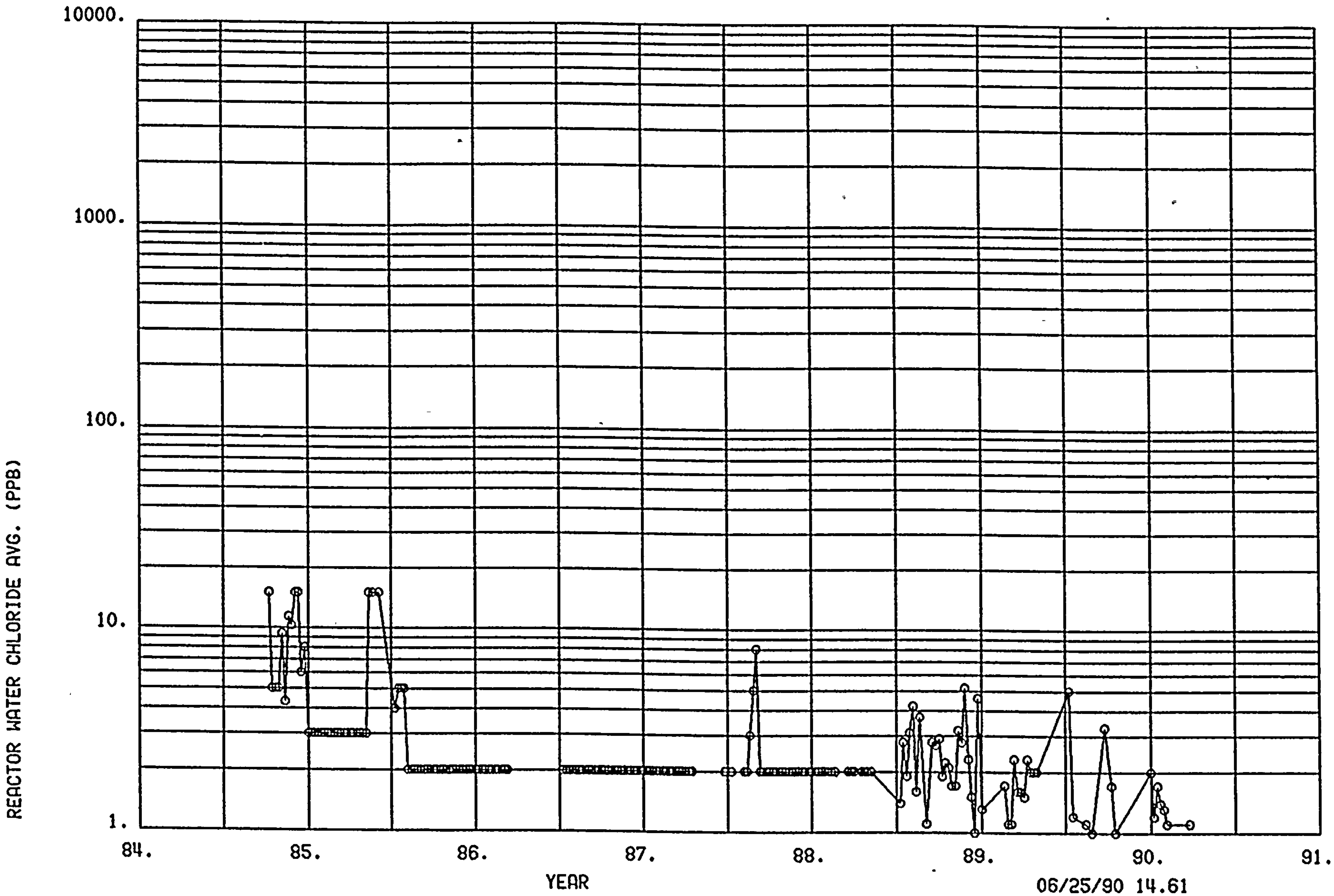
Based on the flaw evaluation results it is determined that WNP-2 may operate for the single cycle evaluation period before reevaluation of the linear indication is again required. The evaluation demonstrates that under the worst imposed loading conditions the flaw meets the acceptance criteria of ASME Section XI Tables IWB-3641-5 and 3641-6. The Fatigue evaluation for the flaw propagation shows that growth due to the piping system mechanical loads is insignificant. The fracture mechanism which can propagate the flaw is intergranular stress corrosion cracking. If the IGSCC phenomena is active the crack will increase in depth to 0.29 inches in the next year which is less than the ASME Code allowable of 0.62 inches per Table IWB-3641-5 and 6.

Revision 1: The weld root and hot passes were performed using gas tungsten-arc welding (GTAW) for an approximate thickness of 1/8 to 3/16 inch. The remainder of the weld was performed utilizing shielded metal arc welding (SMAW). Therefore the acceptance criteria of tables IWB-3641-5 and IWB-3641-6 is used in lieu of IWB-3641-1 and IWB-3641-2.

ATTACHMENT 2

WATER CHEMISTRY HISTORY

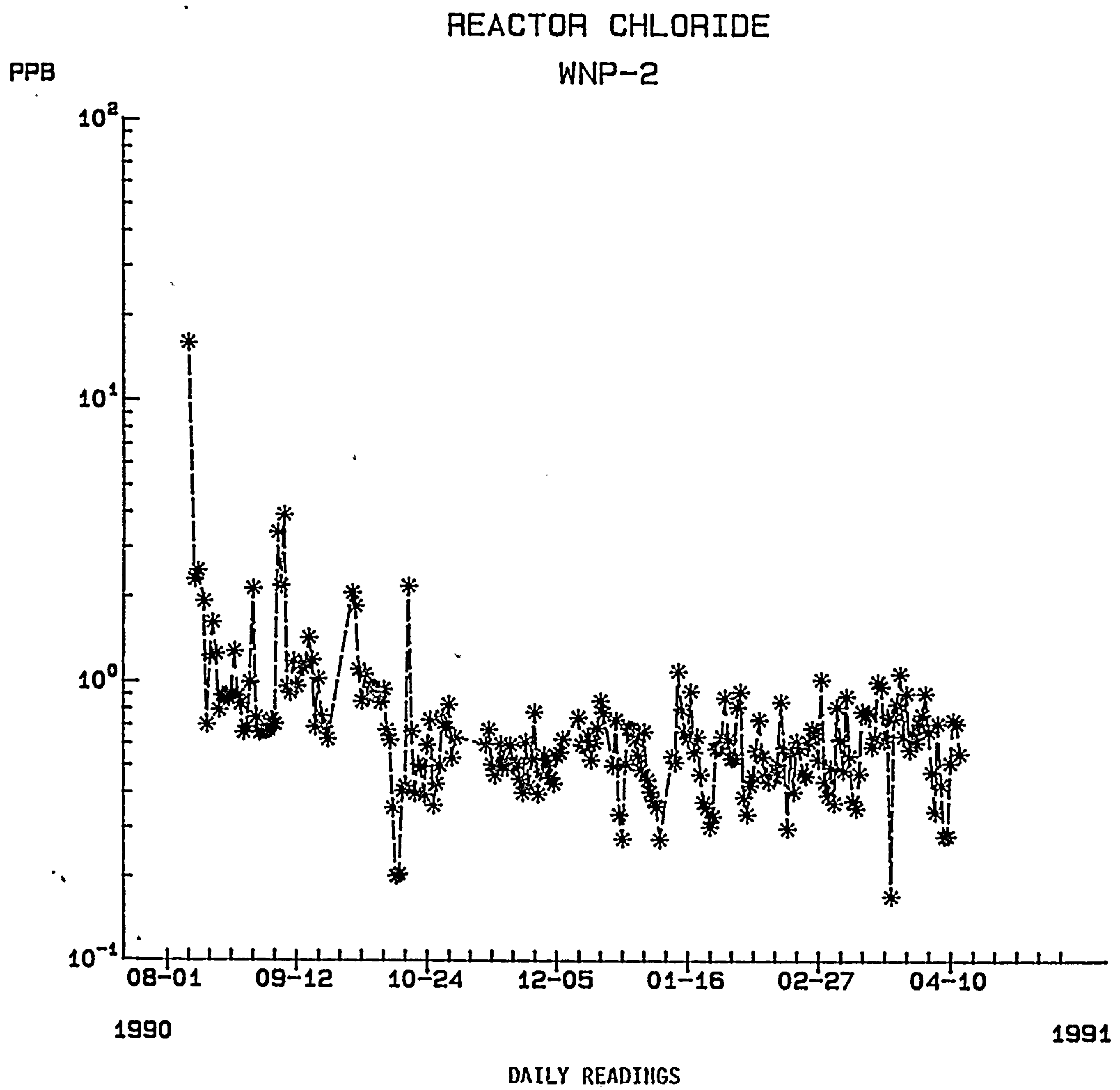
GENERAL ELECTRIC COMPANY



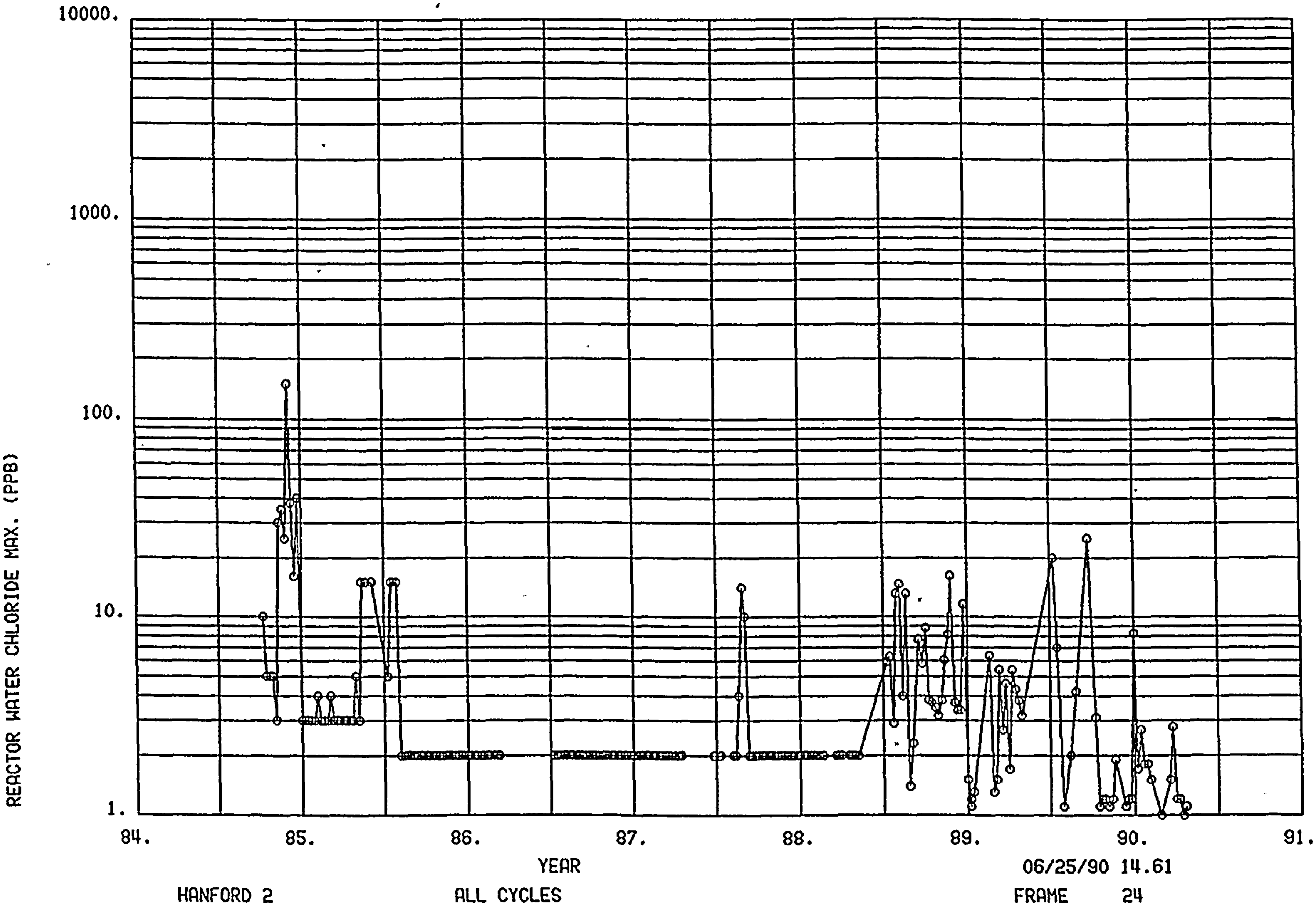
HANFORD 2 ALL CYCLES

06/25/90 14.61
FRAME 18

WEEKLY AVERAGE OF DAILY READINGS

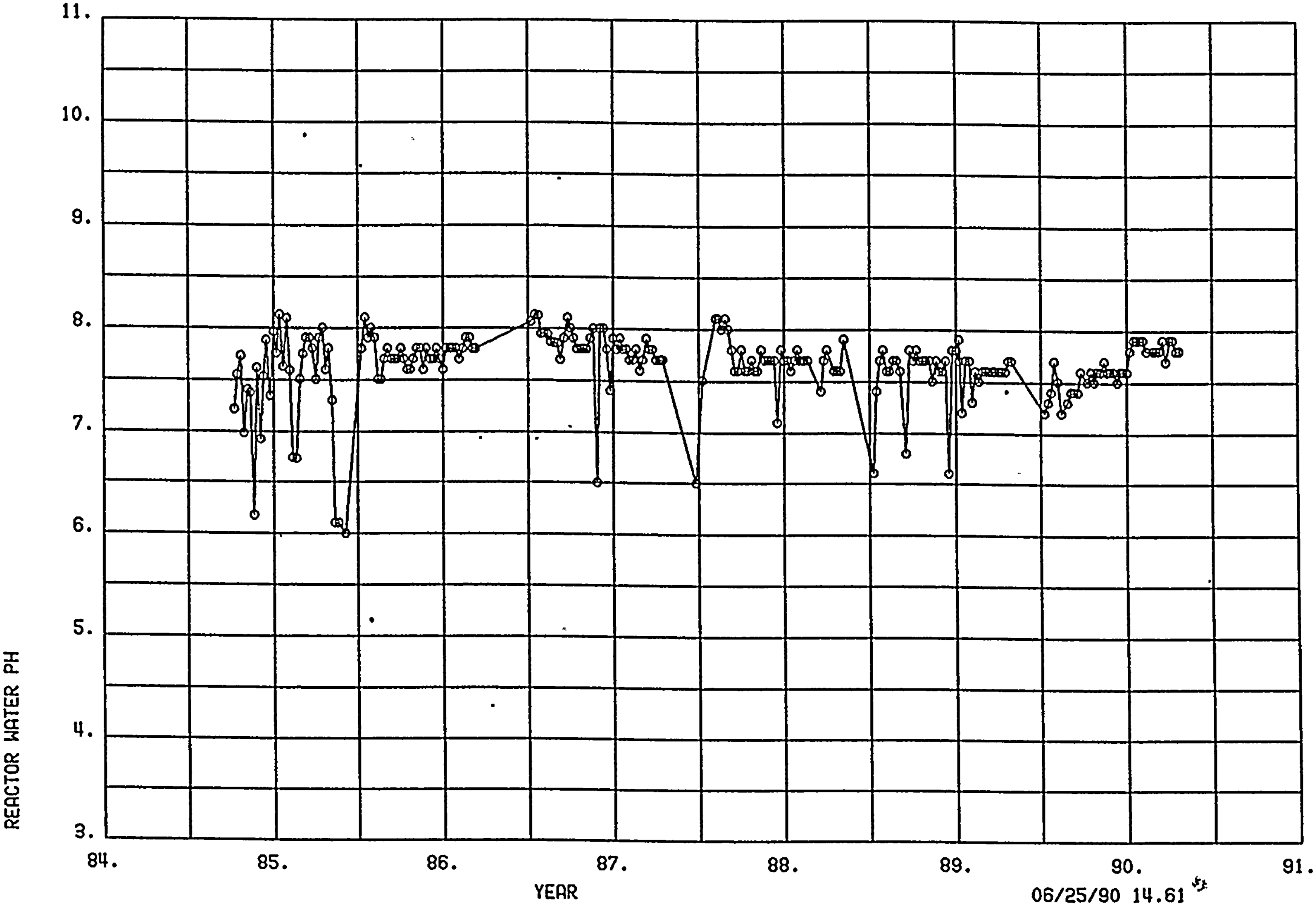

REACTOR CHLORIDE
WNP-2
PPB
10²
10¹
10⁰
10⁻¹
CL
8
08-01
09-12
10-24
12-05
01-16
02-27
04-10
1990
1991
DAILY READINGS

GENERAL ELECTRIC COMPANY



WEEKLY MAXIMUM OF DAILY READINGS

GENERAL ELECTRIC COMPANY



06/25/90 14.61

HANFORD 2 ALL CYCLES

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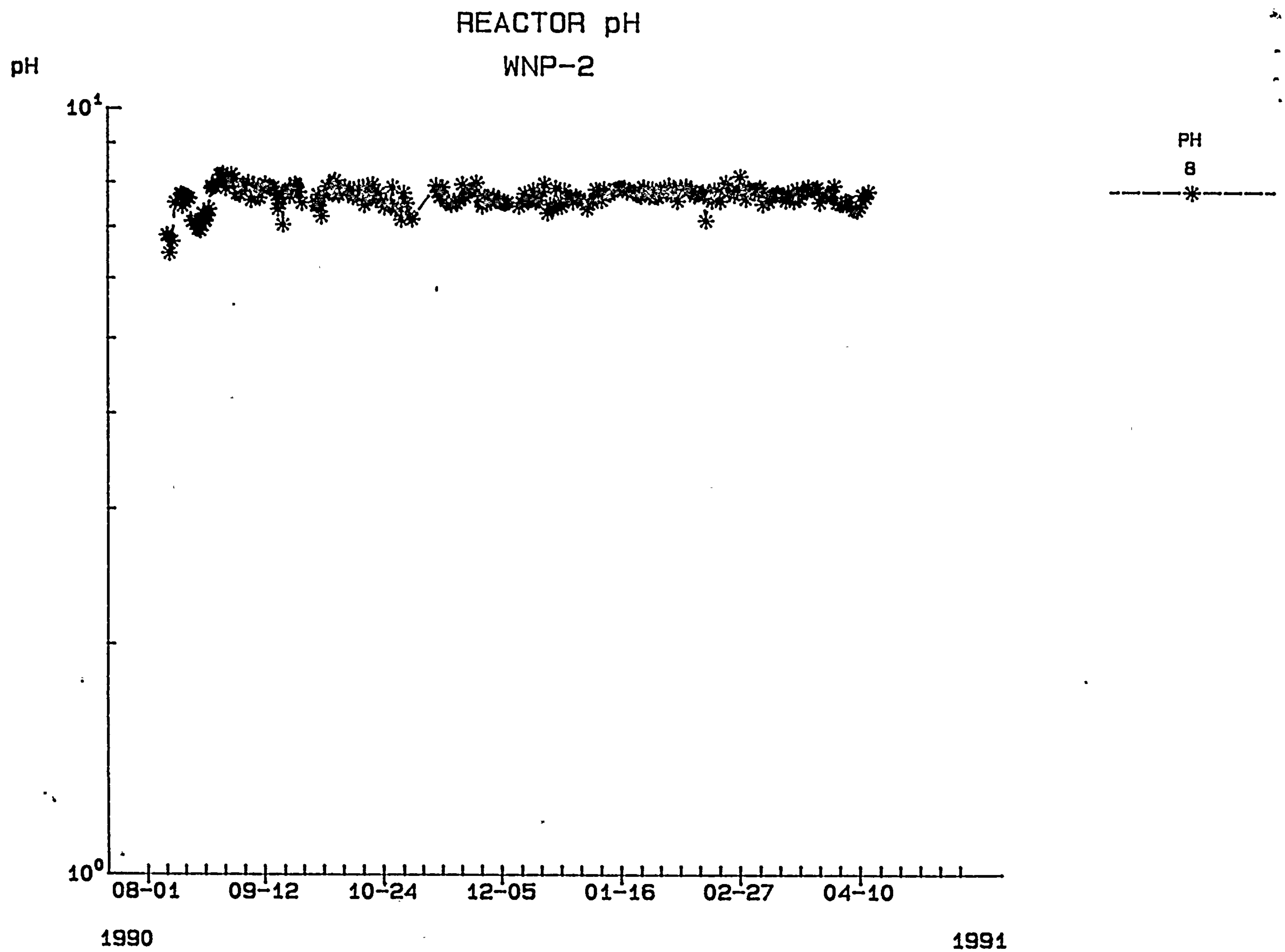
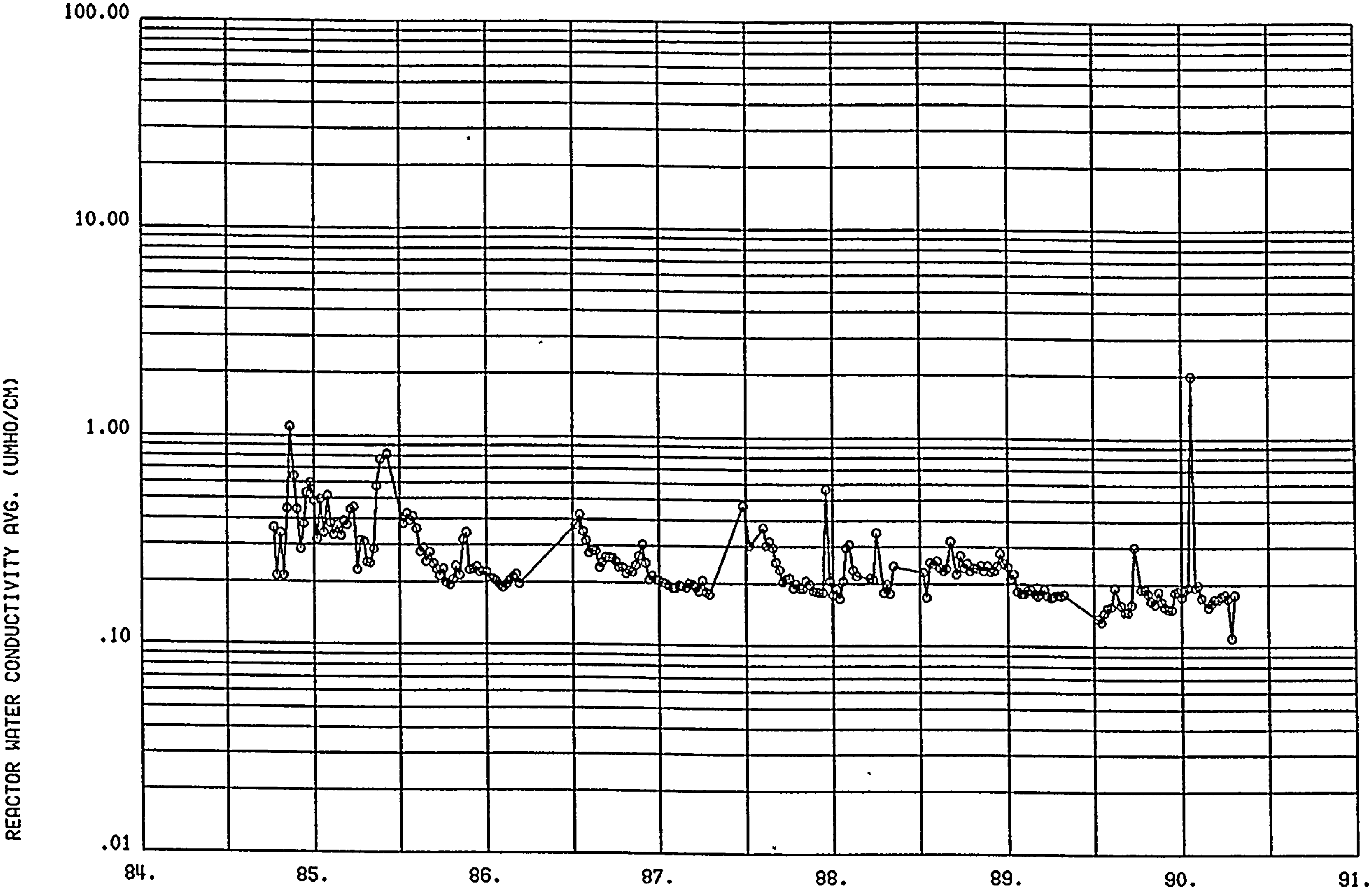

REACTOR pH
WNP-2
pH
10^1
10^0
08-01
09-12
10-24
12-05
01-16
02-27
04-10
1990
1991
PH
8

GENERAL ELECTRIC COMPANY

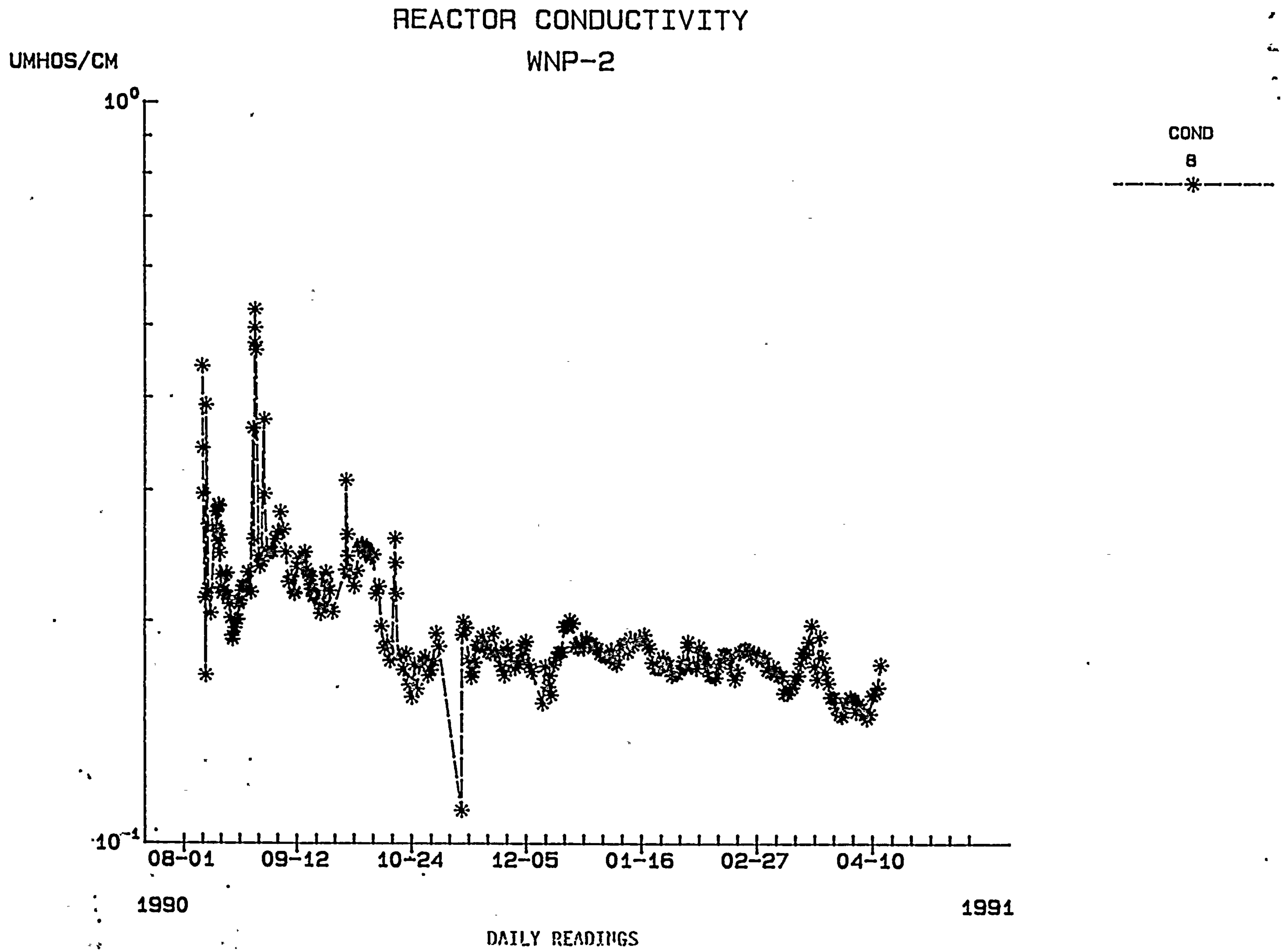


HANFORD 2 ALL CYCLES

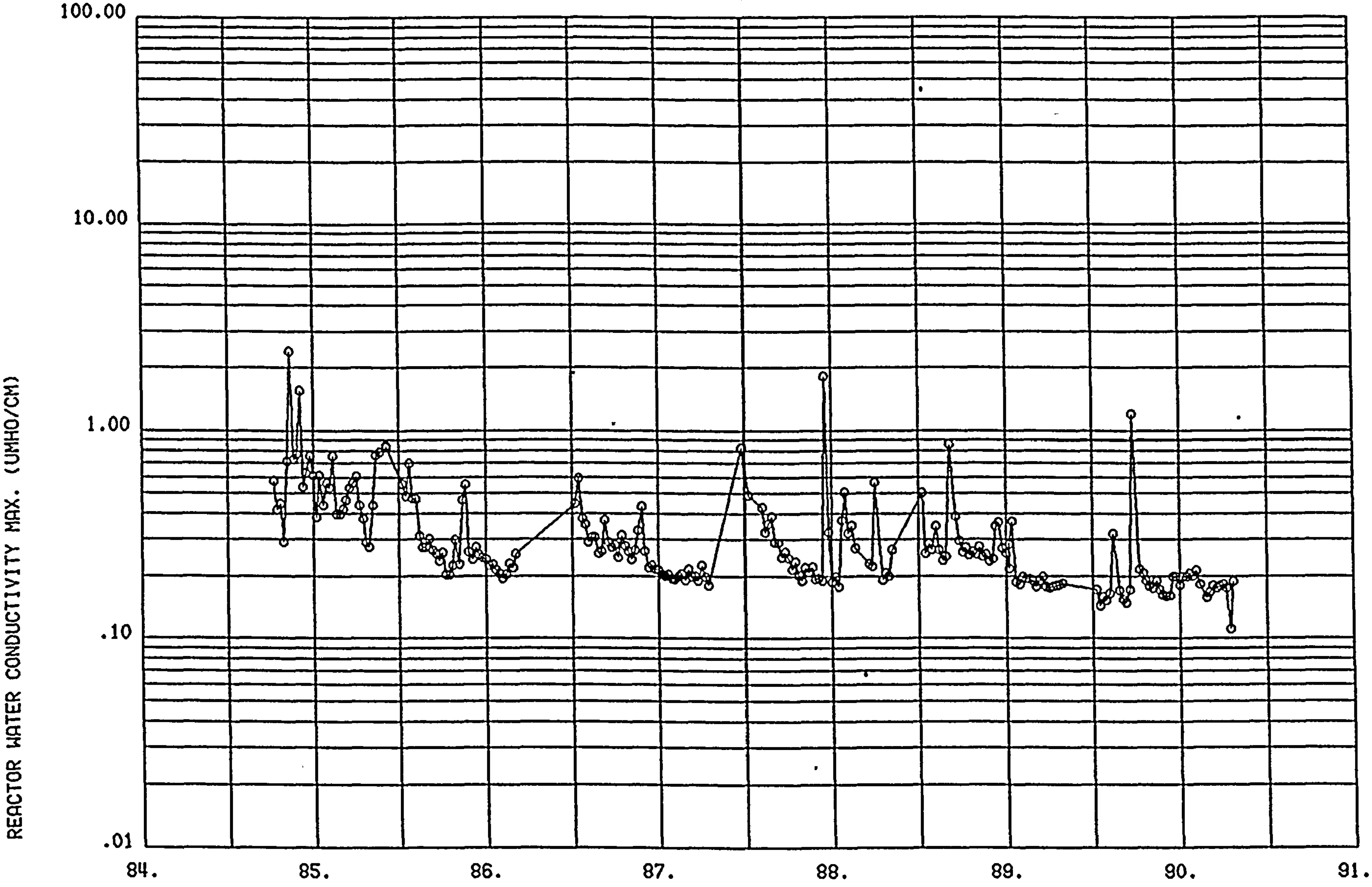
06/25/90 14.61

FRAME 6

WEEKLY AVERAGE OF DAILY READINGS


REACTOR CONDUCTIVITY
WNP-2
UMHOS/CM
10^0
10^{-1}
COND
8
08-01
09-12
10-24
12-05
01-16
02-27
04-10
1990
1991
DAILY READINGS

GENERAL ELECTRIC COMPANY



06/25/90 14.61

HANFORD 2

ALL CYCLES

FRAME 12

WEEKLY MAXIMUM OF DAILY READINGS

12.

ATTACHMENT 3

UT CHARACTERIZATION OF 20RRC(6)-8

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WNP-2 ISI Evaluation Sheet

Evaluation Sheet No.: 1-065	Examination Method: Volumetric ☒ Surface ☐ Visual ☐	Examination Report No.: IRRU-155, IRRU-156
Project: WNP-2	System: RRC	ISI Drawing No.: RRC-105
Originator: DON WELCH	Examination Procedure No.: QCI 6-3 R.0 / 6-25 R.0	Revision No.: 0 / 0

Weld/Part Description: PIPE TO VALVE	Weld/Part No.: 20 RRC (6)-8
Description of Reportable Indication: 60° & 70° RL data length of 2.5" however sizing data of 30/70/70 Result is 4.5". Thru wall data using sizing techniques reveals maximum of 15% thru wall (.15") (a/l = .03 a/t% ISI MAX = 10.66)	Acceptance Criteria: IWB 3514-3 AND IGSCC GO/NOGO Evaluation of Surface or Visual Indication: N/A Acceptable ☐ Rejectable, Submit to RTO ☐

Evaluation of Volumetric Indication (check all applicable boxes):

Acceptable: ☐ See justification below	Geometry: ☐ See justification below	Flaw Size <80% ☐ of acceptance level	Flaw Size ≥80% of acceptance ☒ level, submit to RTO

Justification:

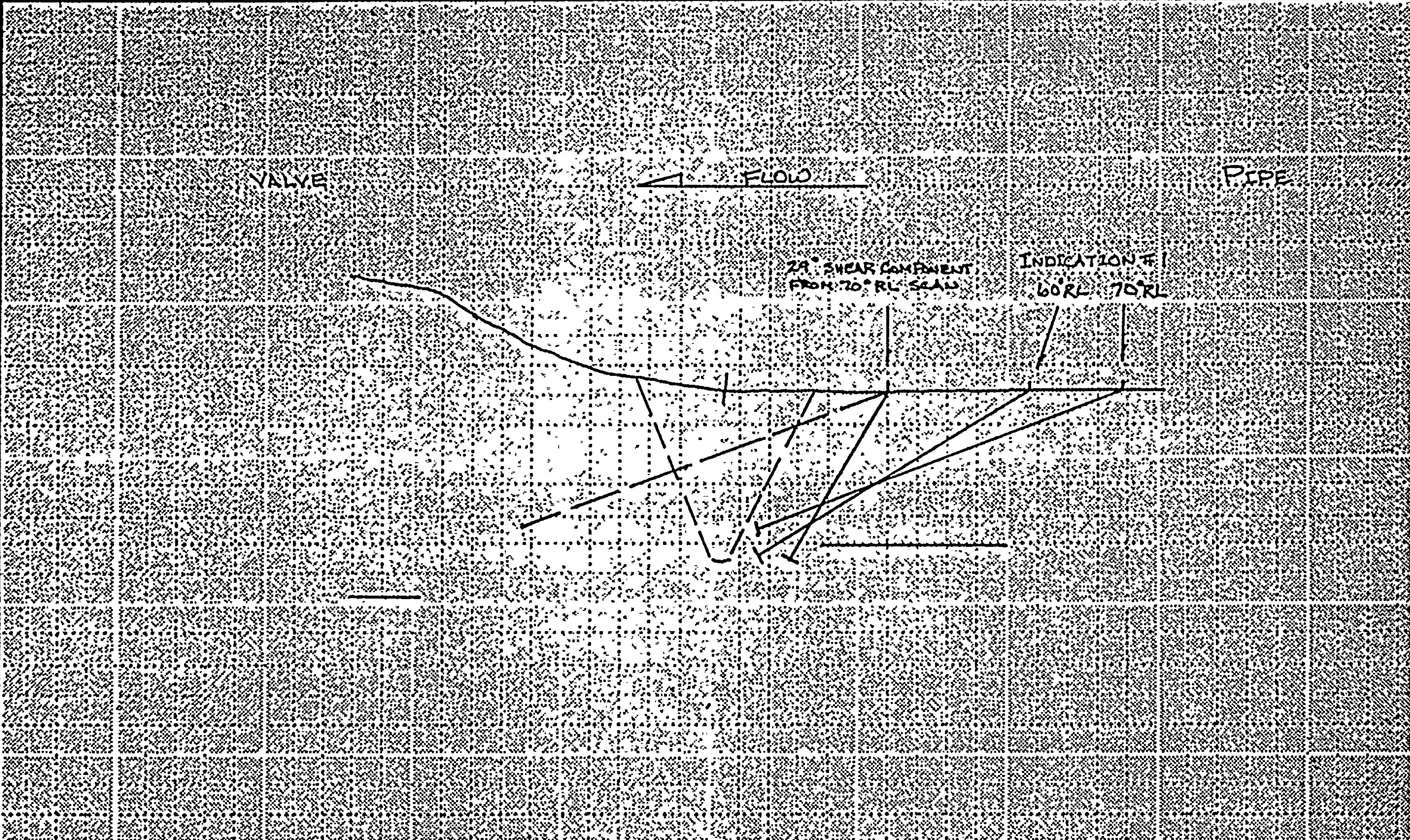
Level III Review:	Date:	RTO Concurrence:	Date:

Reexamination No.:	Results:	Evaluation Sheet No.:

GE Nuclear Energy

INDICATION PLOT SHEET

SITE: WNP-2 UNIT: 2	PROJECT NO: WF-751	REPORT NO. IRRU 155 IRRU 156
SYSTEM: RRC	COMPONENT ID NO: 20RRC(6)-8	CONFIGURATION: PIPE FLOW VALVE



Drawn By	Level	Date	Reviewed By	Level	Date	Reviewed By	Title	Date	Page __ Of __
Wesley C. Money	III	5-3-91	[signature]	III	5-4-91				FORM 137 1-13-90

ATTACHMENT TO EVAL SHT 1-065

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

ULTRASONIC CALIBRATION SHEET

PROJECT: WNP-2	SYSTEM: RRC	SHEET NO.: 314
EXAMINER: Wes Money CE	LEVEL: III	DATE: 5-3-91 / THERMOMETER S/N: 43169-21 4239-21
EXAMINER: Donna L. Hebert GE OCH	LEVEL: II	INSTRUCTION NO.: QCI 6-3 / REVISION: 0

CALIBRATION STANDARD	CALIBRATION STANDARD SIMULATOR	TRANSDUCER	
SERIAL NUMBER UT 9	S/N ___ TEMP ___ °F	S/N RTD 88-319 WAVE MODE RL	CABLE TYPE (2) RG 174
THICKNESS 1.031"	AMP ___ SWEEP ___ IN. N/A	SIZE 2(10x18)mm FREQ 2 MHz	LENGTH 8'
TEMPERATURE 70 °F	GAIN IN db ___	ACTUAL ANGLE 60°	COUPLANT ULTRAGEL II
			BATCH NO. 876A

CHART RECORDER TYPE: N/A	S/N: N/A	UT INSTRUMENT TYPE: SONIC 136	S/N: 020382-21

INSTRUMENT CALIBRATION

PREVIOUSLY PERFORMED ON CALIBRATION SHEET NUMBER N/A

SCREEN HEIGHT LINEARITY FOR CONTINUOUS GAIN CONTROL

HIGH	100.	90	80	70	60	50	40	30	20
LOW	50	45	40	35	30	25	20	15	10

SCREEN HEIGHT LINEARITY FOR 2db STEP GAIN CONTROL (N/A)

db	+2	0	−2	−4	−6	−8	−10	−12	−14
HIGH		80							
LOW		40							

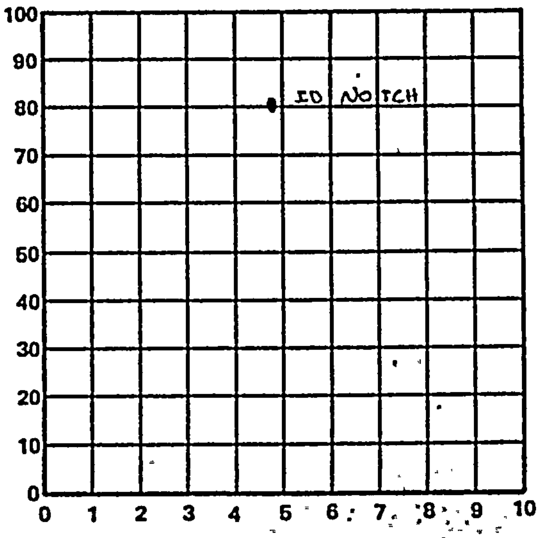
AMPLITUDE CONTROL LINEARITY

AMPLITUDE %	80	80	40	20
db CHANGE	−6	−12	+6	+12
READING %	32	16	90	96
LIMITS %	32 - 48	16 - 24	64 - 96	64 - 96

INITIAL CAL TIME: 1340 | SYSTEM CALIBRATION | FINAL CAL TIME: 1620

INSTRUMENT SETTINGS		REFLECTORS	AMPLITUDE %FSH	SWEEP READING IN INCHES
COARSE RANGE	1.50	4/8 NODE	80%	.96
COARSE DELAY	.405	N/A/8 NODE		
RANGE CALIB	1.50	N/A/8 NODE		
DELAY CALIB	.405	N/A/8 NODE	N	
FREQUENCY	2.25	N/A/8 NODE		A
GAIN IN db	67.6dB	N/A/8 NODE		
DAMPING	500 Ω	N/A/8 NODE		
REJECT	OFF	BKR N/A db		
FILTER	FIL 2	SEARCH UNIT ORIENTATION	☒ AXIAL ☐ CIRCUMFERENTIAL	
		WELDS OR PARTS EXAMINED		
N/A		20RRC(6)-8	N/A	N/A

SCREEN DAC PRESENTATION



FULL SCREEN SWEEP 2 DEPTH IN.

CAL CHECKS: N/A

REVIEWED BY LEVEL III: [signature]	DATE: 5-4-91	REVIEWED BY:	DATE:

968-16286

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

ULTRASONIC EXAMINATION DATA SHEET

REPORT NO.: ~~1~~ 1RRU-155

PROJECT: WNP-2	SYSTEM: RRC	ISI DRAWING NO.: RRC-105 REV 3
WELD/PART DESCRIPTION: 20" PIPE TO VALUE CIR WELD		WELD/PART NO.: 20 RRC (6)-8
MATERIAL TYPE: SS	CAL STANDARD NO.: UT 9	THICKNESS: 1.031
NO. OF SCAN DIRECTIONS: (3) A, C, +D	LIMITED EXAM: ☐ NO * ☒ YES	ACCEPTANCE CRITERIA: QCI 6.3 REV 0

INSTRUCTION NO.: QCI 6-3	REVISION: 0	ANGLE: 60° RL	ANGLE:	ANGLE:
EXAMINER: Wes Money GE	LEVEL: III	DATE: 5-3-91	DATE:	DATE:
EXAMINER: Danny L. Hebert DLH GE	LEVEL: II	TIME START: 1505	TIME START: N/A	TIME START: N/A
		TIME STOP: 1555	TIME STOP:	TIME STOP:
		PART TEMP: 89.6 °F	PART TEMP: °F	PART TEMP:
		CAL SHEET NO.: 314	CAL SHEET NO.:	CAL SHEET NO.:
		CHART NO.: N/A	CHART NO.:	CHART NO.:

THICKNESS MEASUREMENTS

WELD HEIGHT .10" WELD WIDTH 1.2"

SURFACE ONE → SURFACE TWO

	BM	COUNTER BORE	HAZ	WELD ℄	HAZ	COUNTER BORE	BM
0°							
90°				N			
180°					A		
270°							

NOTES: * NO EXAM DNST DUE TO VALUE CONFIGURATION

INDICATION NUMBER	LOCATION INTERVAL A–B OR PART NO. A–B	BEAM ANGLE Ø	SCAN SURFACE	BEAM DIRECTION	SOUND PATH	EXTENT	DAMPABLE	MAX AMP %DAC	100 TO 100 LENGTH	50 TO 50 LENGTH	20 TO 20 LENGTH	SEARCH UNIT POSITION AT MAXIMUM AMP L	W	THROUGH WALL DATA MAXIMUM SP	MAXIMUM D	MINIMUM SP	MINIMUM D	△ SP	△ SP COS Ø	EVALUATION ACCEPT	REJECT
#1	0-90	60°	2	A	2.16"	0.25	N/A	200	1"	2"	2.5"	2.0"	2.05"	N/A							✓

REVIEWED BY LEVEL III: [signature] DATE: 5-4-91 REVIEWED BY: DATE:

968-16293

PAGE 1 OF 1

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

ULTRASONIC CALIBRATION SHEET

PROJECT: WNP-2	SYSTEM: RRC			SHEET NO.: 315	
EXAMINER: Wes Money GE	LEVEL: III	DATE: 5-3-91		THERMOMETER S/N: 43169-21 4239-21	
EXAMINER: Donna L. Hebert DLH GE	LEVEL: II	INSTRUCTION NO.: QCI 6-3		REVISION: 0	

CALIBRATION STANDARD	CALIBRATION STANDARD SIMULATOR	TRANSDUCER	
SERIAL NUMBER UT-9	S/N N/A TEMP °F	S/N RTD 88-322 WAVE MODE RL	CABLE TYPE (2) RG174
THICKNESS 1.031"	AMP SWEEP IN.	SIZE 2(10x18)mm FREQ 2 MHz	LENGTH 8'
TEMPERATURE 70 °F	GAIN IN db	ACTUAL ANGLE 70°	COUPLANT ULTRAGEL II
			BATCH NO. 8764

CHART RECORDER TYPE: N/A	S/N: N/A	UT INSTRUMENT TYPE: SONIC 136	S/N: 020382-21

INSTRUMENT CALIBRATION

PREVIOUSLY PERFORMED ON CALIBRATION SHEET NUMBER N/A

SCREEN HEIGHT LINEARITY FOR CONTINUOUS GAIN CONTROL

HIGH	100	90	80	70	60	50	40	30	20
LOW	50	45	40	35	30	25	20	15	10

SCREEN HEIGHT LINEARITY FOR 2db STEP GAIN CONTROL (N/A)

db	+2	0	−2	−4	−6	−8	−10	−12	−14
HIGH		80							
LOW		40							

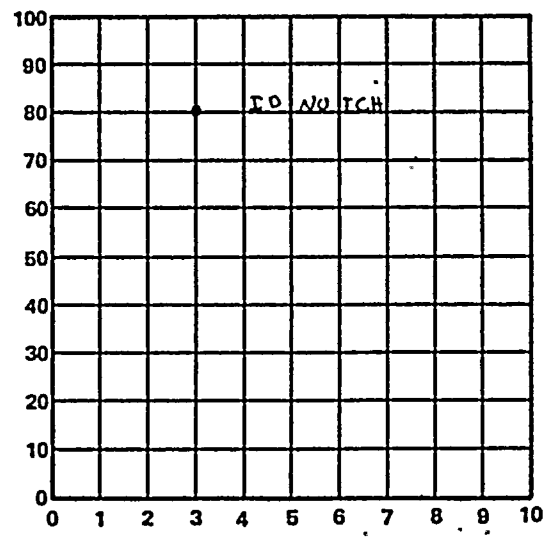
AMPLITUDE CONTROL LINEARITY

AMPLITUDE %	80	80	40	20
db CHANGE	−6	−12	+6	+12
READING %	32	16	90	96
LIMITS %	32 - 48	16 - 24	64 - 96	64 - 96

INITIAL CAL TIME: 1330 — SYSTEM CALIBRATION — FINAL CAL TIME: 1615

INSTRUMENT SETTINGS		REFLECTORS	AMPLITUDE %FSH	SWEEP READING IN INCHES
COARSE RANGE	2.00	4 /8 NODE	80%	.45
COARSE DELAY	.592	N/A /8 NODE	N	A
RANGE CALIB	2.00	/8 NODE		
DELAY CALIB	.592	/8 NODE		
FREQUENCY	2.25	/8 NODE		
GAIN IN db	73.8dB	/8 NODE		
DAMPING	500 Ω	N/A /8 NODE		
REJECT	OFF	BKR N/A db		
FILTER	FIL 2	SEARCH UNIT ORIENTATION ☒ AXIAL ☐ CIRCUMFERENTIAL		
N/A		WELDS OR PARTS EXAMINED: 20RRC(6)-8	N/A	N/A

SCREEN DAC PRESENTATION



FULL SCREEN SWEEP 1.5 DEPTH IN.

CAL CHECKS: N/A

REVIEWED BY LEVEL III: [signature]	DATE: 5-4-91	REVIEWED BY:	DATE:

368-16286

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

ULTRASONIC EXAMINATION DATA SHEET

REPORT NO.: 1RRC-156

PROJECT: WNP-2		SYSTEM: RRC		ISI DRAWING NO.: RRC-105 REV 3	
WELD/PART DESCRIPTION: 20" PIPE TO VALVE CIR WELD				WELD/PART NO.: 20RRC(6)-8	
MATERIAL TYPE: SS		CAL STANDARD NO.: UT-9		THICKNESS: 1.031	
NO. OF SCAN DIRECTIONS: (3) A,C,D		LIMITED EXAM: ☐ NO * ☒ YES		ACCEPTANCE CRITERIA: QCI 6-3 REV 0	
INSTRUCTION NO.: QCI 6-3		REVISION: 0	ANGLE: 70° RL	ANGLE:	ANGLE:
EXAMINER: Wes Money GE		LEVEL: III	DATE: 5-3-91	DATE:	DATE:
EXAMINER: Donna L. Hebert DLH GE		LEVEL: II	TIME START: 1400	TIME START: N/A	TIME START: N/A
			TIME STOP: 1500	TIME STOP:	TIME STOP:
			PART TEMP: 89.6 °F	PART TEMP: °F	PART TEMP: °F
			CAL SHEET NO.: 315	CAL SHEET NO.:	CAL SHEET NO.:
			CHART NO.: N/A	CHART NO.:	CHART NO.:

THICKNESS MEASUREMENTS

WELD HEIGHT .10" WELD WIDTH 1.2"

SURFACE ONE ————→ SURFACE TWO

	BM	COUNTER BORE	HAZ	WELD ℄	HAZ	COUNTER BORE	BM
0°	1.03"	N/A	1.03"	1.15"	N/A	N/A	N/A
90°							
180°				N/A			
270°							

NOTES: * NO EXAM DNST DUE TO VALVE CONFIGURATION
⊕ SHEAR COMPONENT METAL PATH

INDICATION NUMBER	LOCATION INTERVAL A–B OR PART NO. A–B	BEAM ANGLE Ø	SCAN SURFACE	BEAM DIRECTION	SOUND PATH	EXTENT	DAMPABLE	MAX AMP %DAC	LENGTH 100 TO 100	LENGTH 50 TO 50	LENGTH 20 TO 20	SEARCH UNIT POSITION AT MAXIMUM AMP L	W	THROUGH WALL DATA MAXIMUM SP	MAXIMUM D	MINIMUM SP	MINIMUM D	△SP	△SP COS Ø	EVALUATION ACCEPT	REJECT
#1	0-90	70°	2	A	2.66"	0-25"	N/A	100%	1.0"	2.0"	2.5"	2.0"	2.7"	N/A							✓
#1	0-90	70°	2	A	⊕ 1.32"	0-25"	N/A	100%	1.0"	2.0"	2.5"	2.0"	1.1"	N/A						N/A	

REVIEWED BY LEVEL III: [signature] DATE: 5-4-91 REVIEWED BY: DATE:

968-16293

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

ULTRASONIC FLAW SIZING CALIBRATION SHEET

SHEET NO.: 316

Project: WNP-2	Date: 5-4-91	System: RRC
Examiner: P.L. TOMPKINS (PL)	Level: II	Instruction No.: QCI 6-25 Rev 0
Examiner: n/a	Level: n/a	Cable Type: BNC / DUAL LEMO
Couplant: ULTRAGEL II	Batch No.: 8872	Length: 6' to 16'

Transducer Model	S/N	Frequency	Size	Type/Wave Mode	Focal Distance	Nominal Angle
WS4-70-2	56526	2Mhz	1/2" DIA.	30-70-70 CREEP (SINGLE)	n/a	
RTD TRCr2 Aust	86-436	2Mhz	2(6x13mm)	DUAL CREEPING	10mm	
ADEPT 60	158/85	4Mhz?	1/2" dia	DUAL LONG. SHEAR	n/a	
KBA shear	59067	3.5Mhz	1/2" dia	SINGLE SHEAR	n/a	
MEGASONICS Shear	002	1.5Mhz	1/2" dia	SINGLE SHEAR	n/a	

Instrument & Serial #	Screen Height Linearity dB	+2	0	-2	-4	-6	-8	-10	-12	Amplitude Control Linearity % FSH / dB	80 - 6	80 - 12	40 + 6	20 + 12
SONIC 136 C020383	High		80							% FSH				
	Low		40											
	High		80							% FSH	n/a			
	Low		40			n/a								
	High		80							% FSH				
	Low		40											
	High		80							% FSH				
	Low		40											

Calibration Standard S/N: UT-95		Calibration Standard S/N: n/a	
Thickness: 1"	Temp: 77°	Thickness:	Temp °F:
Initial Cal Time: 12:15	Final Cal Time: 15:25	Thermometer S/N:	

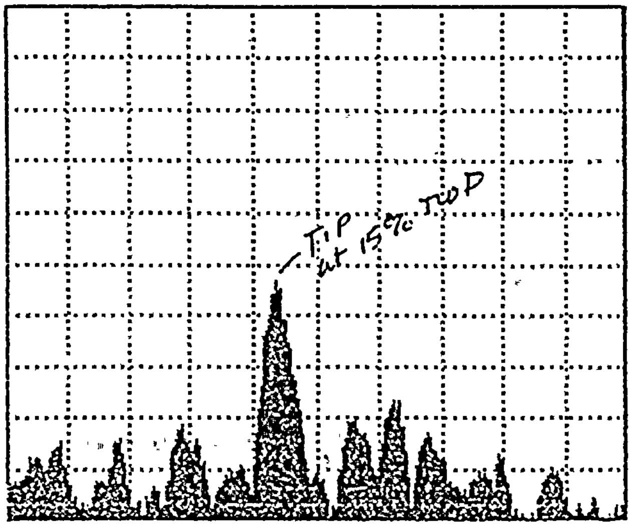
Method	30-70-70 (1)	HGTL Creeping (2)	MOST (3)	SHEAR (4)	SHEAR (5)	(6) SHEAR
Transducer	WS4-70-2	RTD TR Cr2 Aust	Adept 60	45° 3.5Mhz Shear	45° 3.5Mhz Shear	45° 1.5Mhz Shear
Cal Block	UT-95	UT-95	UT-95	UT-95	UT-95	UT-95
Screen Presentation	.31=40% FSH .21=30% FSH .11=10% FSH cc1 6.8DIV cc2 7.5DIV	1 DIV = 10% TWD 2 DIV = 20% TWD	1 DIV 50% TWD 4 DIV 20% TWD	SPOT 10% TWD ALL DIV 40% TWD TO 4 DIV. TP CORNER	TIPS 60% TWD 2 DIV PATT 20% TWD 8 DIV	IASCC cal 1/2 V notch 80% 8 DIV UT-9 cal block
Instrument S/N	SONIC 136	SONIC 136	SONIC 136	SONIC 136	SONIC 136	SONIC 136
Single/Dual	SINGLE	DUAL	DUAL	SINGLE	SINGLE	SINGLE
Frequency	2.25 Mhz	2.25 Mhz	2.25 Mhz	5 Mhz	5 Mhz	1 Mhz
Gain	63	64	68	52	54	44
Coarse Sweep	n/a	n/a	n/a	n/a	n/a	n/a
Fine	5.24	1.00	2.80	.746	1.52	2.50
Delay	.503	.1738	1.11	1.33	.335	.335
Damping	500Ω 222nS	500Ω 222nS	500Ω 222nS	500Ω 100nS	500Ω 100nS	500Ω 100nS
Calibration Simulator	FILTER 2 .227 in/uS	FILTER 2 .135 in/uS	FILTER 2 .227 in/uS	FILTER 1 0.127 in/uS	FILTER 1 .127 in/uS	Filter 3 .127" uS
Cal Check						
Cal Check						

Welds or Parts Examined:		
20RRC(6)-8		

Reviewed By: [signature]	Date: 5-4-91	Reviewed By:	Date:

STAVELEY INSTRUMENTS — SONIC 136 PLUS DATA REPORT

STORED DISPLAY # 1 CAL PROGRAM 3 - MOST



RANGE		RECEIVER	
RANGE	2.80in	GAIN	74.0dB
DELAY	1.11in	DISPLAY	FILT2
VEL	0.227 in/us	FREQ	2.25MHz
UNITS	in	REJECT	OFF

GATE		PULSER	
LEVEL	OFF	PULSE	222nS
POSN	1.81in	DAMPING	500
WIDTH	0.701in	DUAL	
POLARITY	+	REP RATE	4 KHz

GAIN REFERENCE	
GAIN	74.0dB
REF LVL	~~40.0dB~~ 66 PLT
% CHANGE	XXXX
dB CHANGE	34.0

INSPECTION REPORT

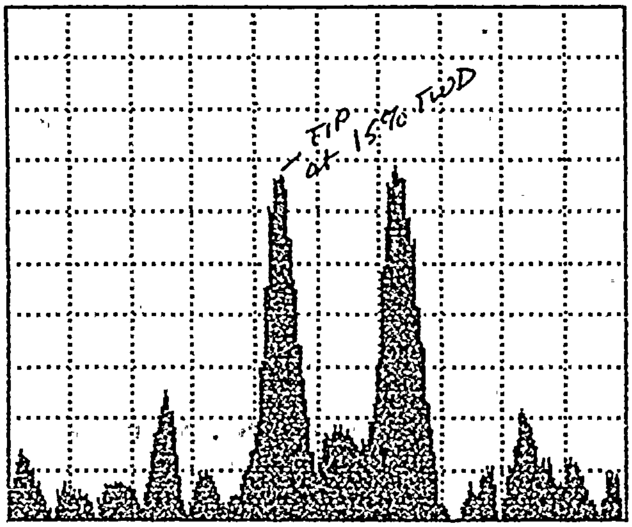
COMPANY	Supply System
ADDRESS	
OPERATOR	P.L. TOMPKINS
TIME	13:47
INSP. PROCEDURE	QCI 6-25 Rev. C
CODE/SPEC	
ACCEPTANCE LEVEL	SIZING
JOB NUMBER	
OBJECT	
MATERIAL	SS
TRANSDUCER TYPE	ADEPT 60 - MOST
COMMENTS	
SIGNATURE	Paul L. Tompkins
DATE	5-4-91

ATTACHMENT TO

IRRU-157

STAVELEY INSTRUMENTS – SONIC 136 PLUS DATA REPORT

STORED DISPLAY # 2 CAL PROGRAM 3 - MOST



RANGE		RECEIVER	
RANGE	2.80in	GAIN	74.0dB
DELAY	1.11in	DISPLAY	FILT2
VEL	0.227 in/us	FREQ	2.25MHz
UNITS	in	REJECT	OFF

GATE		PULSER	
LEVEL	OFF	PULSE	222nS
POSN	1.81in	DAMPING	500Ω
WIDTH	0.701in	DUAL	
POLARITY	+	REP RATE	4 KHz

GAIN REFERENCE	
GAIN	74.0dB
REF LVL	~~40.0dB~~ 65
% CHANGE	XXXX
dB CHANGE	34.0

INSPECTION REPORT

COMPANY: Supply System

ADDRESS:

OPERATOR: P. L. TOMPKINS TIME: 13:50

INSP. PROCEDURE: QCI 6-25 Rev 0

CODE/SPEC:

ACCEPTANCE LEVEL: SIZING

JOB NUMBER:

OBJECT: MATERIAL: SS

TRANSDUCER TYPE: ADEPT 60 MOST

COMMENTS:

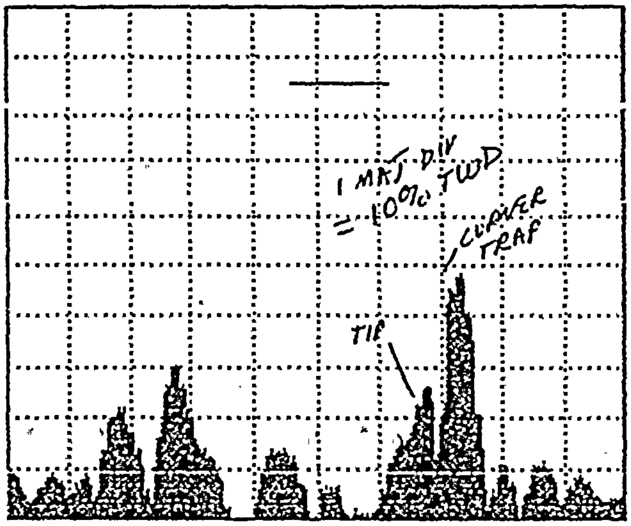
SIGNATURE: Paul L. Tompkins DATE: 5-4-91

ATTACHMENT TO
1RRU-157

STAVELEY INSTRUMENTS — SONIC 136 PLUS DATA REPORT

CAL PROGRAM #4 SPOT

STORED DISPLAY # 3



RANGE		RECEIVER	
RANGE	0.746in	GAIN	66.2dB
DELAY	1.33in	DISPLAY	FILT1
VEL	0.127 in/us	FREQ	5MHz
UNITS	in	REJECT	OFF
GATE		**PULSER**	
LEVEL	85%	PULSE	100nS
POSN	1.68in	DAMPING	500
WIDTH	0.119in	PULSE ECHO	
POLARITY	+	REP RATE	4 KHz
GAIN REFERENCE			
GAIN	66.2dB		
REF LVL	~~36.2dB~~ 52 PLR		
% CHANGE	XXXX		
dB CHANGE	30.0		

INSPECTION REPORT

COMPANY Supply System

ADDRESS

OPERATOR P.L. Tompkins TIME 14:10

INSP. PROCEDURE QCI 6-25 Rev. 0

CODE/SPEC

ACCEPTANCE LEVEL SIZING

JOB NUMBER

OBJECT MATERIAL SS

TRANSDUCER TYPE ~~ADEPT 60~~ PLR ~~A1057~~ PLR SPOT 3.5 Mhz shear 45°

COMMENTS

SIGNATURE Paul L. Tompkins DATE 5-4-91

ATTACHMENT TO

IRRU-157

INPUT TO THE FLAW EVALUATION

Stress (Loads) Evaluation

The stress state at the location of the flaw is required to determine the driving force for crack propagation. Stresses for the applicable loading conditions were extracted from the ASME Class 1 Stress Report for the subject RHR piping (Calculation No. 8.14.107) to complete the RHR piping flaw evaluation.

The input data and loads for the RHR-V-113 flaw evaluation are tabulated below.

Pipe Stresses and Geometry:

Deadweight (Dwt)	1494 psi
Pressure (P)	6062 psi
Upset	1754 psi
Emergency	1907 psi
Faulted (F)	3275 psi
Thermal NPO (TH)	1050 psi

Total Load Dwt + P + TH + F = 11881 psi

Physical Dimensions:

Nominal Pipe OD.	20 in.
Nominal Pipe Thick.	1.031 in.
Moment of Inertia	2770 in^4

Material Allowable:
SA-358 type 304 S_m=16675 psi.

Load Combinations:

The following load combinations were evaluated to determine if the crack would grow under the imposed loads. The evaluations (fatigue and intergranular stress corrosion cracking (IGSCC)) encompass the requirements of IWB-3640.

> The imposed load for fatigue evaluation consists of superimposing the pressure, deadweight bending, normal operating thermal bending stress and the weld residual stress to complete the evaluation of the minimum fracture stress intensity. Pressure, deadweight bending, and thermal bending stresses are conservatively combined with the worst case faulted dynamic bending stresses (without regard to the direction of the applied stress) to complete the evaluation of the maximum fracture stress intensity range. This methodology conservatively includes faulted dynamic stresses in the normal/upset evaluation and conservatively adds additional thermal stresses into the faulted evaluation. The number of dynamic loading cycles is based on the design basis main steam safety relief valve actuations which yield approximately 300 stress cycles per year. The peak dynamic loading also includes 300 cycles of the Safe Shutdown Earthquake event even though the plant design basis is 10 stress cycles.

Fatigue Stress: Dwt + P + TH + F = 11881 psi

The IGSCC evaluation was completed using the steady state deadweight pressure and bending stress and the normal plant operation thermal stress.

IGSCC Stress: Dwt + P + TH = 8606 psi

In each loading condition the above stress states were then superimposed on the weld residual stress distribution to complete the respective flaw evaluations. The resulting flaw sizes were then evaluated against the end of evaluation period depth-to-thickness ratios from Tables IWB-3641-5 and IWB-3641-6.