August 2, 1984

Docket No. 50-271

LICENSEE: Vermont Yankee Nuclear Power Corporation

FACILITY: Vermont Yankee Nuclear Power Station

SUBJECT: SUMMARY OF MEETING HELD ON JULY 26, 1984 TO DISCUSS THE VERMONT YANKEE NUCLEAR POWER STATION PIPE CRACK INSPECTIONS

BACKGROUND

On July 26, 1984, representatives of the Vermont Yankee Nuclear Power Corporation (VYNPC) met with NRC staff members at Bethesda, Maryland to brief the staff on the results of pipe crack inspections performed at Vermont Yankee during the 1984 refueling outage. The licensee considers that the results of the inspections justify plant operation through the 1984/85 operating cycle and proposes to resume plant operation on August 2, 1984 if NRC approval is obtained. The licensee's presentation is described in Enclosure 1. Enclosure 2 lists the meeting attendees.

SUMMARY

The licensees described the status of the Vermont Yankee plant following the 1983 inspections. The 1984 inspection program and scope was explained, and details of inspection results were presented. The equipment, methods, and personnel qualifications used in 1984 were compared with those used in 1983.

Results in 1984 were compared with 1983 results. Discrepancies between results in 1983 and 1984 not explainable by IGSCC were represented to be attributable to improvements in testing. Flaw evaluation methods were summarized and overlays performed in 1984 were described.

VYNPC representatives compared the inspection results and sample expansion performed at Vermont Yankee with the GL 84-11 inspection program and sample expansion, and provided support for terminating further sample expansion based on technical and personnel exposure considerations.

The NRC staff advised VYNPC that no conclusion could be reached as to the adequacy of inspection until additional information was provided, reviewed, and found to be acceptable.

Such information would include:

1. Commitment to provide local leak detection effective for monitoring all uninspected 28" welds.

2. Commitment for pipe replacement in 1985.

3. Details of crack inspection results sufficient to independently confirm the adequacy of the evaluation.

4. A final inspection report containing the full informational needs detailed in technical discussions during the meeting.

If the staff finds such support for operation to be acceptable, the staff intends to issue an order confirming items 1 and 2.

Original signed by/

Vernon L. Rooney, Project Manager
Operating Reactors Branch #2
Division of Licensing

Enclosures:
As stated

cc w/enclosures:
See next page

DISTRIBUTION
Docket File
NRC PDR
Local PDR
ORB#2 Reading
ORB#2 Mtg Summary File
DVassallo
VRooney
OELD
ELJordan
JNGrace
ACRS (10)
NRC Participants
NSIC

DL:ORB#2	DE:MTEB	DL:ORB#2
VRooney:ajs		DVassallo
08/2/84	08/ /84	08/7/84

Mr. J. B. Sinclair
Vermont Yankee Nuclear Power Corporation
Vermont Yankee Nuclear Power Station

cc:

Mr. W. F. Conway
President & Chief Executive Officer
Vermont Yankee Nuclear Power Corp.
R. D. 5, Box 169
Ferry Road
Brattleboro, Vermont 05301

Mr. Donald Hunter, Vice President
Vermont Yankee Nuclear Power Corp.
1671 Worcester Road
Framingham, Massachusetts 01701

New England Coalition on
Nuclear Pollution
Hill and Dale Farm
R. D. 2, Box 223
Putney, Vermont 05346

Mr. Walter Zaluzny
Chairman, Board of Selectman
Post Office Box 116
Vernon, Vermont 05345

J. P. Pelletier, Plant Manager
Vermont Yankee Nuclear Power Corp.
Post Office Box 157
Vernon, Vermont 05354

Raymond N. McCandless
Vermont Division of Occupational
& Radiological Health
Administration Building
10 Baldwin Street
Montpelier, Vermont 05602

Honorable John J. Easton
Attorney General
State of Vermont
109 State Street
Montpelier, Vermont 05602

John A. Ritscher, Esquire
Ropes & Gray
225 Franklin Street
Boston, Massachusetts 02110

W. P. Murphy, Vice President &
Manager of Operations
Vermont Yankee Nuclear Power Corp.
R. D. 5, Box 169
Ferry Road
Brattleboro, Vermont 05301

U. S. Environmental Protection
Agency
Region I Office
Regional Radiation Representative
JFK Federal Building
Boston, Massachusetts 02203

Public Service Board
State of Vermont
120 State Street
Montpelier, Vermont 05602

Vermont Yankee Decommissioning
Alliance
43 State Street
Montpelier, Vermont 05602-2964

Resident Inspector
U. S. Nuclear Regulatory Commission
Post Office Box 176
Vernon, Vermont 05354

Vermont Public Interest
Research Group, Inc.
43 State Street
Montpelier, Vermont 05602

Thomas A. Murley
Regional Administrator
Region I Office
U. S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, Pennsylvania 19406

Mr. Richard Saudek, Commissioner
Vermont Department of Public Service
120 State Street
Montpelier, Vermont 05602

ENCLOSURE 1

VERMONT YANKEE

PIPE INSPECTION PROGRAM

SUMMARY

JULY 26, 1984

OVERVIEW OF PRESENTATION

o	STATUS OF PLANT FOLLOWING IE BULLETIN 83-02 INSPECTIONS	W.P. MURPHY
o	GENERAL SCOPE OF 1984 INSPECTIONS	
o	DESCRIPTION OF 1984 UT INSPECTION PROGRAM	L.E. MULLINS
o	DETAILED SCOPE OF 1984 INSPECTIONS	
o	RESULTS OF 1984 INSPECTIONS	
o	COMPARISON OF 1983 AND 1984 INSPECTIONS	
o	SUMMARY OF FLAW EVALUATION METHODS	R.E. WHITE
o	OVERLAYS PERFORMED IN 1984	
o	BASIS FOR 28" PIPE INSPECTION SCOPE	J.R. HOFFMAN
o	SUMMARY AND CONCLUSIONS	W.P. MURPHY

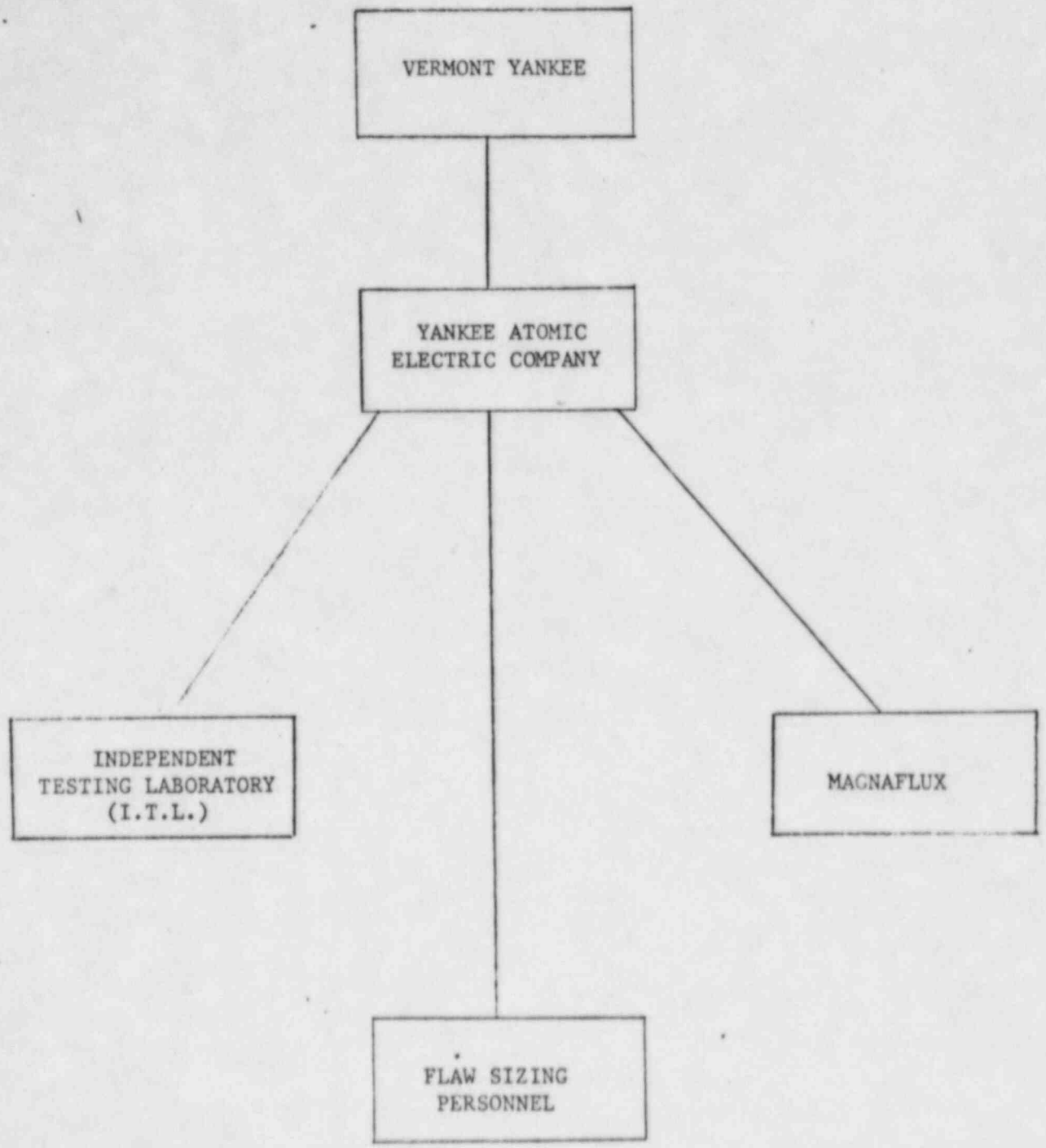
STATUS OF PLANT AFTER IE BULLETIN 83-02 INSPECTIONS

- 58 of 113 SUSCEPTIBLE WELD JOINTS INSPECTED
- FLAWS IDENTIFIED IN 34 WELD JOINTS
- OVERLAYS PERFORMED ON 22 RISER WELDS
- FRACTURE MECHANICS ANALYSIS PERFORMED ON 12 LARGE BORE WELDS - NO REPAIRS REQUIRED
- LOCAL LEAK DETECTION INSTALLED ON 7 UNINSPECTED WELDS
- REACTOR COOLANT LEAKAGE LIMITS TIGHTENED TO MEET NRC CRITERIA
- JCO SUBMITTED ON MARCH 13, 1984 FOR OPERATION THROUGH 1984/85 CYCLE

- PROPOSED 1984 INSPECTION OF 47 WELD JOINTS IN ACCORDANCE WITH THE INTENT OF SECY 83-267C

SCOPE OF 1984 INSPECTION PROGRAM

- COMPLIES WITH NRC GENERIC LETTER 84-11, EXCEPT AS NOTED BELOW
- INITIAL SAMPLE INCLUDED
  - ALL 12 UNREPAIRED CRACKED WELDS IN 22", 24" and 28" PIPING
  - 17 OVERLAYS WITH PREVIOUS CRACKS LONGER THAN 10% OF PIPE CIRCUMFERENCE
  - 9 OF 26 PREVIOUSLY INSPECTED, UNCRACKED WELDS, COMPRISING 20% (MINIMUM OF 2) OF SUCH WELDS IN 4 PIPE SIZES (12", 22", 28" and 20")
  - 17 OF 55 PREVIOUSLY UNINSPECTED WELDS, COMPRISING 20% (MINIMUM OF 4) OF SUCH WELDS IN 4 PIPE SIZES (22", 28", 20" and 24")
  - TOTAL OF 55 WELDS IN INITIAL SAMPLE
- SECOND SAMPLE INCLUDED
  - BALANCE OF PREVIOUSLY UNINSPECTED, SUSCEPTIBLE 22" WELDS (TOTAL OF 2)
  - BALANCE OF PREVIOUSLY UNINSPECTED 20" WELDS (TOTAL OF 2)
  - 5 OF 18 REMAINING PREVIOUSLY UNINSPECTED 28" WELDS
- THIRD SAMPLE INCLUDED
  - 5 OF 13 REMAINING PREVIOUSLY UNINSPECTED 28" WELDS (VICE 13 of 13 REQUIRED BY EXPANSION CRITERIA OF GENERIC LETTER 84-11)
- TOTAL OF 14 WELDS IN ADDITIONAL SAMPLES
- NO INCREASED SAMPLE REQUIRED IN 12" and 24" PIPING
- INSPECTION EFFORT INCLUDED 69 OF 77 WELD JOINTS REQUIRED BY THE SAMPLING CRITERIA OF GENERIC LETTER 84-11


VERMONT YANKEE
YANKEE ATOMIC ELECTRIC COMPANY
INDEPENDENT TESTING LABORATORY (I.T.L.)
MAGNAFLUX
FLAW SIZING PERSONNEL

	1983	1984
EQUIP.	P 710B	P-SCAN ALN 4060 USIP 11 USL 30 (SERIES) P710
PROBES	45°S DUAL 1.5 MHZ 60°S DUAL 1.5 MHZ	45° S 1.5 MHZ 52° S 1.5 MHZ 45° S 2.25 MHZ 52° S 2.25 MHZ RTD 70° RL 4 MHZ RTD 70° RL 2 MHZ WSY 70-2 WSY 70-4 52° 5 HZ SLIC 40
CALIB.	10% NOTCH - 6 DB	10% NOTCH - 64 DB
SCAN	-10 DB	UNLIMITED

DATA RECORDING	MANUAL DATA MANUAL MEASUREMENTS	AUTO AUTO
PLOTTING	MANUAL	P-SCAN SHARP 600 MANUAL
PERSONNEL	1 LVL III 4 LVL II ≈ 30 LVL I	3 LVL III 8 LVL II ≈ 25 LVL I
SIZING QUAL	NONE	E.P.R.I. PROG
TRAINING	IN HOUSE	E.P.R.I
QUALIFYING EXAM	83-02 TEAM	E.P.R.I INDIV

83'

84'

SIZING

DB DROP

HALT
PATT
SPOT
MOST
FULL VEE

V.Y. 1984 I.G.S.C.C. QUALIFICATIONS

Bob Keys	Level III	ITL	Semiautomatic Qualification Using P-Scan
Joel Harrison	Level II	ITL	Semiautomatic Qualification Using P-Scan
C.E. Brinkley	Level II	ITL	Semiautomatic Qualification Using P-Scan
Martin Peacock	Level II	ITL	Semiautomatic Qualification Using P-Scan
C.E. Brinkley	Level II	ITL	EPRI NDE Center Mod. 17
Wade Holloway	Level I	ITL	EPRI NDE Center Mod. 17
Bruce Reekie	Level II	Niagara Mohawk	EPRI NDE Center Mod. 17
Dave Marudas	Level III	Morrison-Knudsen Co.	EPRI NDE Center Mod. 17
Mike Sherwin	Level III	Magnaflux	Mag. TP 83-13-22
Dean Mansfield	Level II	Magnaflux Quality Serv.	Magnaflux 22.A.35
Nicholas Tulloh	Level II	Magnaflux	EPRI NDE Center Mod. 17
Mark Nodini	Level II	Magnaflux	Mag. 22.A.35
Lawrence Mullins	Level II	Yankee Atomic	EPRI NDE Center Mod. 17
Lawrence Mullins	Level II	Yankee Atomic	EPRI NDE Center ALN 4060 Manual

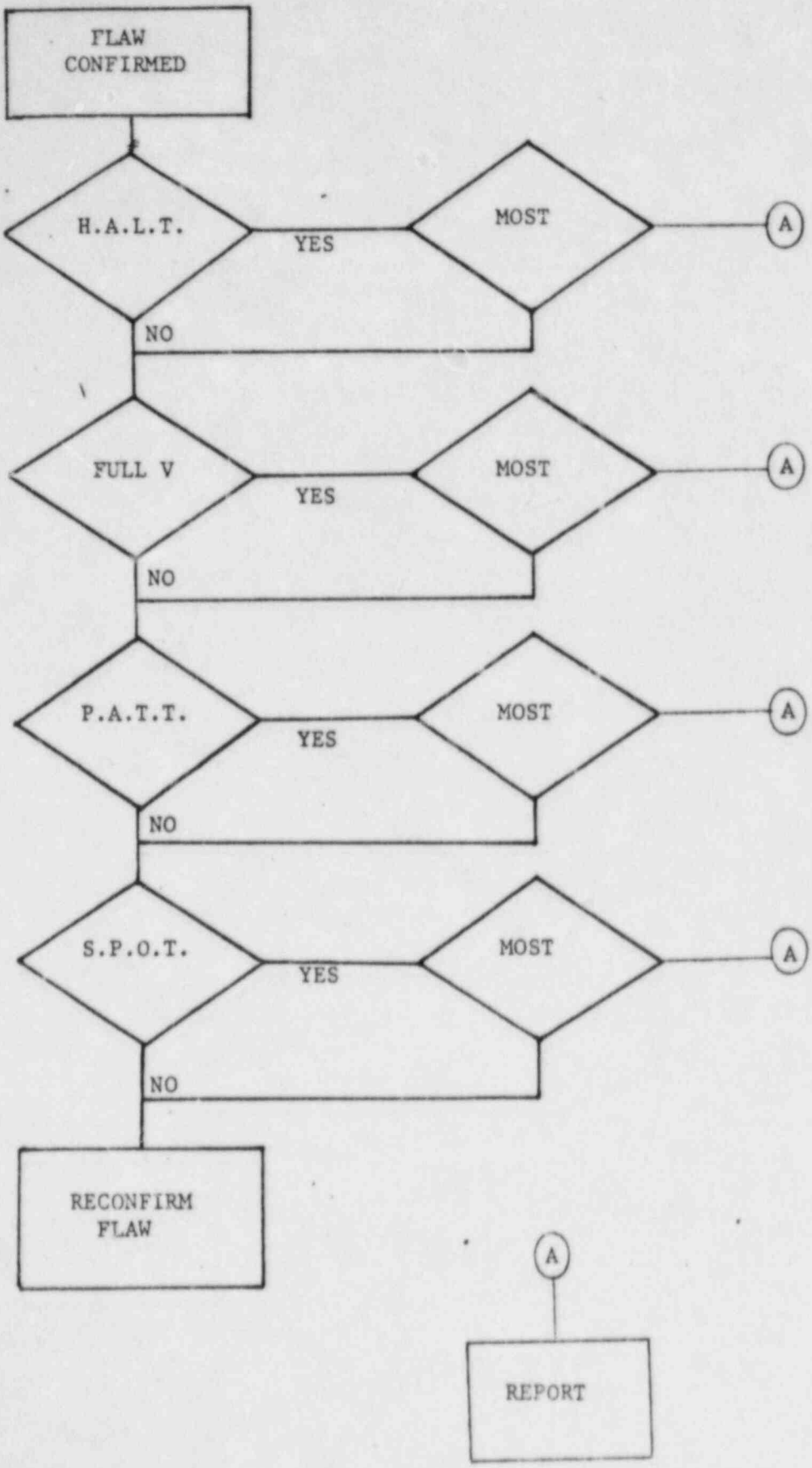
WELD OVERLAY TECHNIQUES

CLAD BOND

- 0° LONGITUDINAL BEAM
- CALIBRATION
  - .375" FLAT BOTTOM HOLE

CLAD INTEGRITY

- 45° DUAL ELEMENT REFRACTED LONGITUDINAL PROBE
- 1.5 MHz
- CALIBRATION
  - .062 SIDE DRILLED HOLE


FLAW CONFIRMED
H.A.L.T.
YES
MOST
A
NO
FULL V
YES
MOST
A
NO
P.A.T.T.
YES
MOST
A
NO
S.P.O.T.
YES
MOST
A
NO
RECONFIRM FLAW
A
REPORT

Date ____

SUMMARY

PIPE SIZE	83 INSP	FLAW	84 INSP	FLAW
12 INCH-ORIGINAL OVERLAYS	22	22	17	
12 INCH-UNREPAIRED	18		4	
20 INCH	1		7	1
22 INCH	6	3	11	5
24 INCH	1	1	5	
28 INCH	12	8	25	11
TOTALS	60	34	69	17

Date _____

SUMMARY

	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
IGSCC-UNREP		12	12	5	7	
OVERLAYS-ORIG		12	12	12		
PREV-NO IGSCC		9	9	8	1	
REMAINING		17	17	12	5	
EXPANDED-1		7	7	4	3	
EXPANDED-2		2	2	2		
EXPANDED-3		5	5	4	1	
EXPANDED-OVERLAYS		5	5	5		
TOTALS		69	69	52	17	0

Date ____

OVERLAYS - ORIGINALS

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
12-24		1	1	1		
12-18		1	1	1		
12-29		1	1	1		
12-16		1	1	1		
12-32		1	1	1		
12-23*		1	1	1		
12-35		1	1	1		
12-36*		1	1	1		
12-51		1	1	1		
12-50		1	1	1		
12-54		1	1	1		
12-53		1	1	1		
TOTALS		12	12	12	0	0

VERMONT YANKEE

WELD INSPECTION

MATRIX

Date ____

12 INCH-ORIGINAL OVERLAYS

WELD #	83 INSP	FLAW	84 INSP	FLAW
12-24	1	1	1	
12-32	1	1	1	
12-29	1	1	1	
12-54	1	1	1	
12-51	1	1	1	
12-18	1	1	1	
12-35	1	1	1	
12-33	1	1	1	
12-30	1	1	1	
12-16	1	1	1	
12-53	1	1	1	
12-36*	1	1	1	
12-34	1	1		
12-25	1	1		
12-42	1	1	1	
12-45	1	1	1	
12-50	1	1	1	
12-20	1	1	1	
12-23*	1	1	1	
12-40	1	1		
12-31	1	1		
12-52	1	1		
TOTALS	22	22	17	0

Date ____

PREVIOUS - NO IGSCC

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
12-51A		1	1	1		
12-54A		1	1	1		
12-41		1	1	1		
12-44		1	1	1		
20-RHR32-4		1	1		1	
22-23A		1	1	1		
22-30A		1	1	1		
28-9B		1	1	1		
28-17		1	1	1		
TOTALS		9	9	8	1	0

VY - RECIRC ISI Date ____

IGSCC- UNREPAIRED

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
22-16B		1	1		1	
22-30B		1	1		1	
22-36B		1	1	1		
24-RHR31-1		1	1	1		
28-64		1	1	1		
28-1A		1	1		1	
28-2		1	1		1	
28-9A		1	1		1	
28-65A		1	1		1	
28-15A		1	1	1		
28-58		1	1	1		
28-59		1	1		1	
TOTALS		12	12	5	7	

Date ____

WELD #	REMAINING 83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
22-16A		1	1		1	
22-47		1	1	1		
22-48		1	1	1		
22-36A		1	1	1		
28-61		1	1		1	
28-15		1	1	1		
28-15B		1	1		1	
28-27		1	1		1	
28-26A		1	1		1	
20-ARHR32-1		1	1	1		
20-ARHR32-2		1	1	1		
20-ARHR-32-F-1		1	1	1		
20-ARHR-32-5		1	1	1		
24-CRHR30-1		1	1	1		
24-CRHR30-3		1	1	1		
24-CRHR-30-9		1	1	1		
24-CHR-30-10		1	1	1		
TOTALS		17	17	12	5	0

Date ____

EXPANDED - 1

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
22-49		1	1		1	
22-23B		1	1		1	
28-17A		1	1	1		
28-15C		1	1	1		
28-4		1	1	1		
28-5A		1	1	1		
28-17B		1	1		1	
TOTALS		7	7	4	3	0

Date ____

EXPANDED - 2

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
20-32-6		1	1	1		
20-32-7\		1	1	1		
TOTALS		2	2	2	0	0

Date ____

EXPANDED - 3

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
28-5		1	1	1		
28-6		1	1		1	
28-8		1	1	1		
28-56		1	1	1		
28-26		1	1	1		
TOTALS		5	5	4	1	0

Date _____

EXPANDED -OVERLAYS

WELD #	83 INSP	INSP	EVAL COMPL	OK	FLAW	OL
12-30 \		1	1	1		
12-33		1	1	1		
12-42		1	1	1		
12-45		1	1	1		
12-20		1	1	1		
TOTALS		5	5	5	0	0

12 INCH - UNREPAIRED

WELD # \	Date 83 INSP	FLAW	84 INSP	FLAW
12-54A	1		1	
12-51A	1		1	
12-18A	1			
12-21A	1			
12-40A	1			
12-43A	1			
12-44	1		1	
12-41	1		1	
12-21	1			
12-24A	1			
12-31A	1			
12-19	1			
12-28A	1			
12-34A	1			
12-28	1			
12-43	1			
12-22	1			
12-55	1			
TOTALS	18	0	4	0

	Date			
20 INCH				
	83		84	
WELD #	INSP	FLAW	INSP	FLAW
20-ARHR32-1			1	
20-ARHR32-2			1	
20-ARHR32-F-1			1	
20-ARHR32-5			1	
20-RHR32-4	1		1	1
20-32-6			1	
20-32-7			1	
TOTALS	1	0	7	1

Date _____

22 INCH

WELD #	83 INSP	FLAW	84 INSP	FLAW
22-16B	1	1	1	1
22-30B	1	1	1	1
22-23A	1		1	
22-30A	1		1	
22-36B	1	1	1	
22-46	1			
22-16A			1	1
22-47			1	
22-48			1	
22-36A			1	
22-49			1	1
22-23B			1	1
TOTALS	6	3	11	5

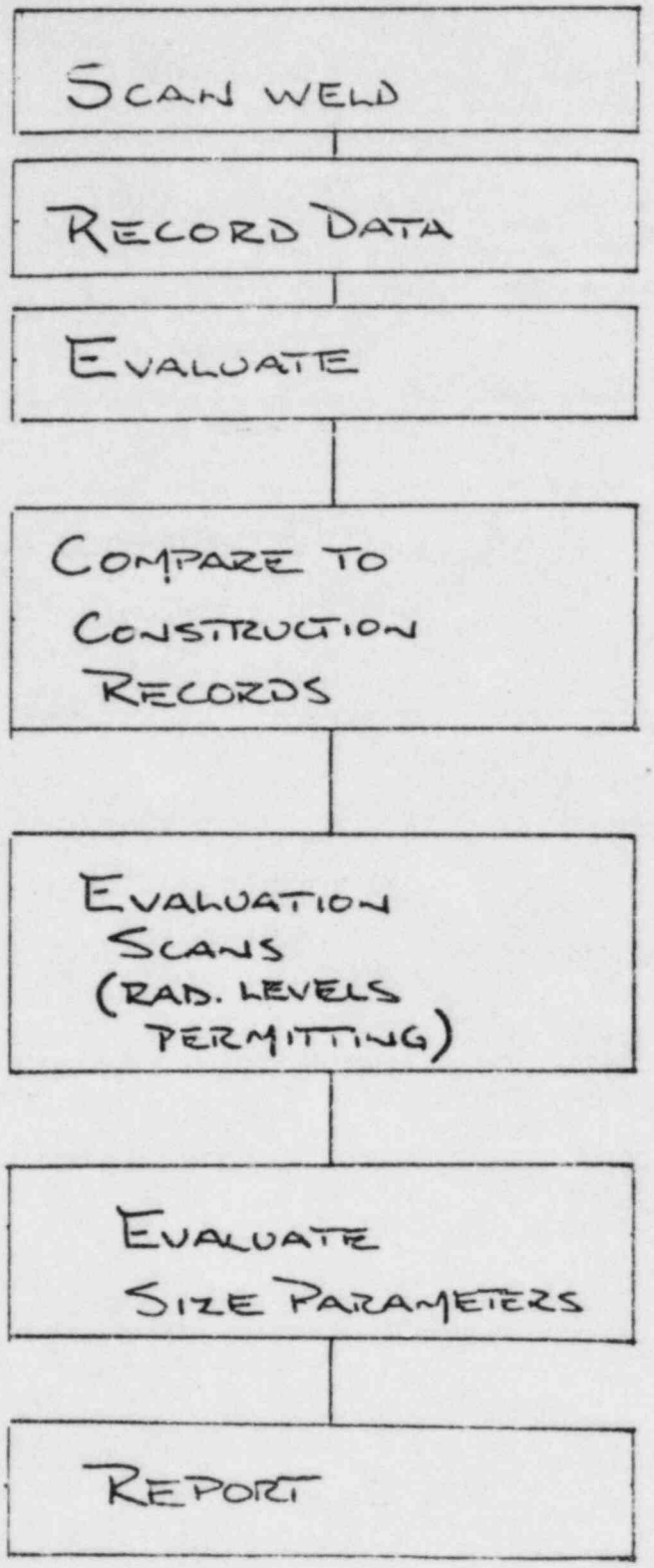
	Date			
24 INCH				
WELD #	83 INSP	FLAW	84 INSP	FLAW
24-RHR31-1	1	1	1	
24-CRHR30-1			1	
24-CRHR30-3			1	
24-CRHR30-9			1	
24-CRHR30-10			1	
TOTALS	1	1	5	0

Date

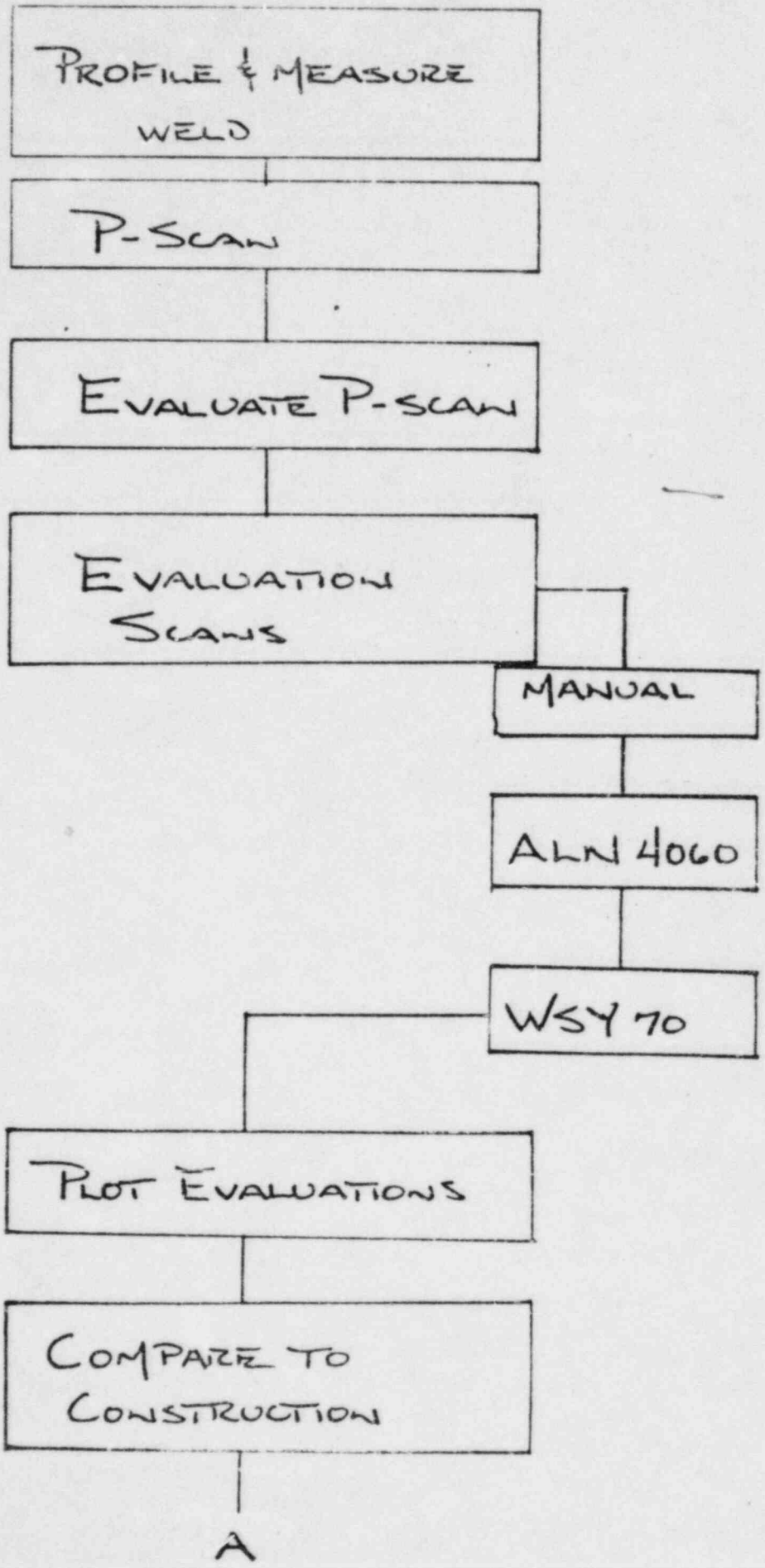
28 INCH

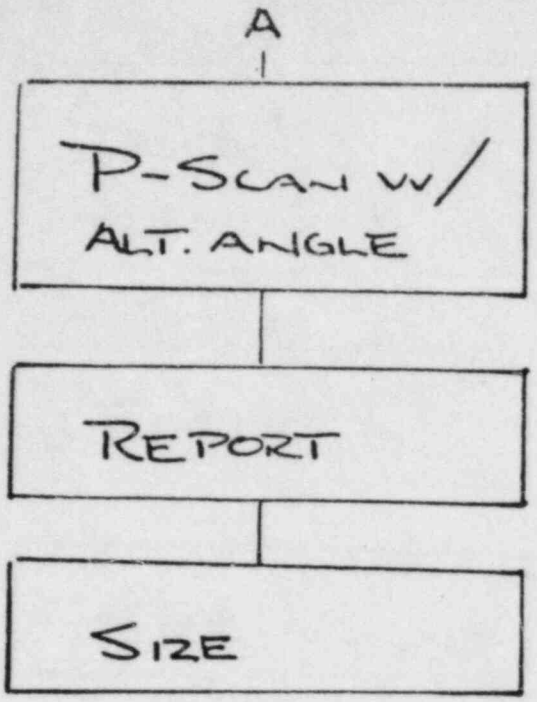
WELD #	83 INSP	FLAW	84 INSP	FLAW
28-38	1			
28-2	1	1	1	1
28-9A	1	1	1	1
28-65A	1	1	1	1
28-1A	1	1	1	1
28-9B	1		1	
28-64	1	1	1	
28-15A	1	1	1	
28-17	1		1	
28-58	1	1	1	
28-59	1	1	1	1
28-66	1			
28-61			1	1
28-15			1	
28-15B			1	1
28-27			1	1
28-26A			1	1
28-17A			1	
28-15C			1	
28-4			1	
28-5A			1	
28-17B			1	
28-5			1	
28-6			1	1
28-8			1	
28-56			1	
28-26			1	
TOTALS	12	8	25	11

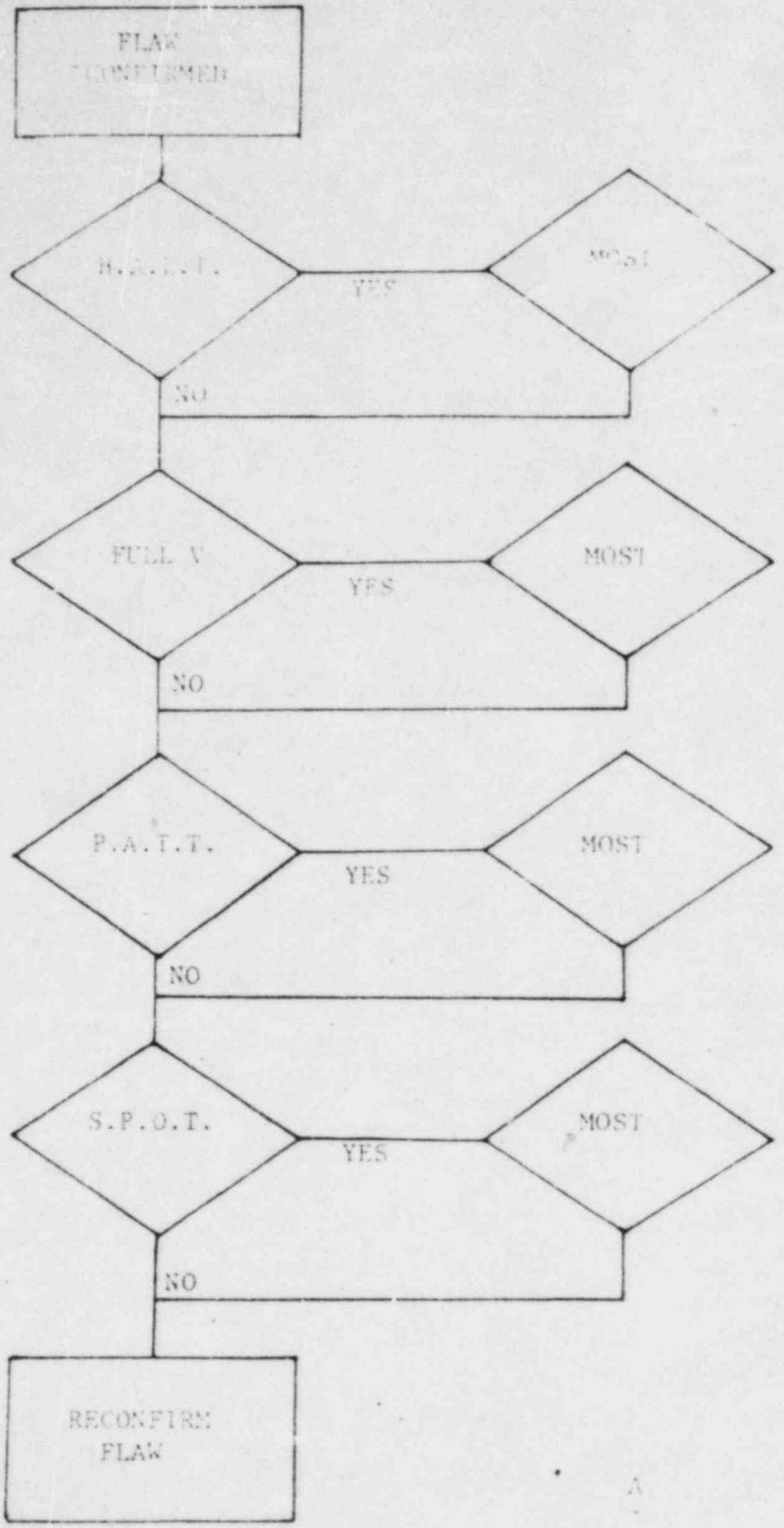
1983


SCAN WELD
RECORD DATA
EVALUATE
COMPARE TO CONSTRUCTION RECORDS
EVALUATION SCANS (RAD. LEVELS PERMITTING)
EVALUATE SIZE PARAMETERS
REPORT

1984


PROFILE & MEASURE WELD
P-SCAN
EVALUATE P-SCAN
EVALUATION SCANS
MANUAL
ALN 4060
WSY 70
PLOT EVALUATIONS
COMPARE TO CONSTRUCTION
A


A
P-SCAN W/
ALT. ANGLE
REPORT
SIZE


FLAW
CONFIRMED
B.A.L.T.
YES
MOST
NO
FULL V
YES
MOST
NO
P.A.T.T.
YES
MOST
NO
S.P.O.T.
YES
MOST
NO
RECONFIRM
FLAW

SUMMARY OF FLAW EVALUATION RESULTS

o GENERAL

LINEAR ELASTIC FRACTURE MECHANICS ANALYSIS PERFORMED TO THE CRITERIA OF ASME CODE, SECTION XI, WINTER, 1983, ADDENDA WITH ADDED CONSERVATISMS.

o FACTORS ON RESULTS

IN ACCORDANCE WITH GENERIC LETTER 84-11 AND DRAFT NUREG 1061:

* END OF CYCLE FLAWS LIMITED TO 2/3 x SECTION XI, IWB 3640 ALLOWABLE FLAWS.

* THERMAL EXPANSION STRESSES CONSIDERED PRIMARY AND INCLUDED IN $(P_M + P_B)$ VALUE.

* WELD OVERLAY SHRINKAGE STRESSES FROM 1983 ALSO INCLUDED IN $(P_M + P_B)$.

o APPLIED STRESSES

* CRACK GROWTH PREDICTION BASED ON A COMBINATION OF
  - DEADWEIGHT
  - \+ PRESSURE
  - \+ WELD RESIDUAL
  - \+ THERMAL EXPANSION
  - \+ SHRINKAGE RESIDUAL

* WELD RESIDUAL STRESS DISTRIBUTION BASED ON RECOMMENDATIONS OF DRAFT NUREG 1061 (FIGURE 3-1).

* Operating stresses conservatively treated as thru wall membrane stress.

* Bending stress components include stress intensification factors which are more representative of higher stresses in crotch of fittings than of butt welds.

o <u>Crack Model and Crack Growth Analysis</u>

* A full 360° circumferential crack on pipe inside surface is assumed even though indications are finite.

* Model consists of 360° circumferential flaw in cylinder with t/R ratio = 0.1.

* Best estimate severely weld sensitized crack growth law (Figure 3-2) is numerically integrated to predict flaw depth as a function of time on structural integrity associates program <u>VISICRACK - IGSCC - 6.</u>

* Analytical technique identical to that recently submitted for Millstone I.

Details Of UT Indications And Weld Joint Stresses

Pipe Size	Weld ISI No.	(2) (P+DW+OBE+Th) / S_m	Orient	a/T (%)	L/circ* (1) (in)
28"	1A	0.87	C	22	5.0
	2	0.70	C	15	2.0
	15B	0.83	C	27	3.0
	26A	0.74	C	15	19.0
	27	0.63	C	19	4.5
	61	0.54	C	20	24.0
	59	0.56	C	21	13.0
	65A	0.57	C	23	15.0
	9A	0.59	C	20	5.0
	17B	0.58	C	20	6.0
	6	0.58	C	17	3.0
22"	16A	0.69	C	20	7.0
	16B	0.88	C	12	0.8
	30B	0.49	C	20	24.0
	49	0.57	C	22	1.5
	23B	0.49	C	27	6.0

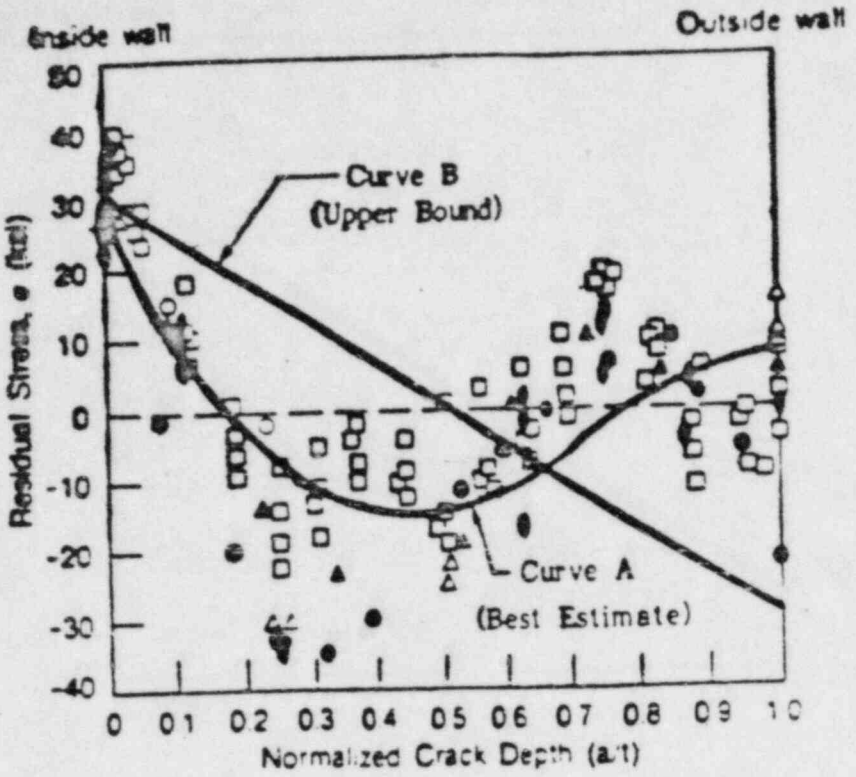
(1) Total length of all circumferential indications at the weld.

(2) Includes application of stress intensification factors.

TABLE III

Summary of Predicted Crack Growth For A 12-Month Operating Period

Weld ISI No.	Circumferential Flaw Size				Allowable Flaw Size	
	Start Depth a/t(%)	Final Depth a/t(%)	Start Length (in)	Final Length (in)	Start Of Cycle Depth a/t	End Of Cycle Depth a/t
1A	22		5.0		0.30	0.5
2	15		2.0		0.40	0.5
15B	27		3.0		0.43	0.5
26A	15		19.0		0.39	0.5
27	19		4.5		0.42	0.5
61	20		24.0		0.47	0.5
59	21		13.0		0.47	0.5
65A	23		15.0		0.45	0.5
9A	20		5.0		0.44	0.5
17B	20		6.0		0.44	0.5
6	17		3.0		0.44	0.5
16A	20		7.0		0.43	0.5
16B	12		0.8		0.35	0.5
30B	20		24.0		0.47	0.5
49	22		1.5		0.47	0.5
23B	27		6.0		0.47	0.5



LEGEND:

- O GE 26 in NP944-1
- □ GE 26 in IHSI ref. pipe (4 azimuths)
- ▲ ANL 26 in ND 944-2 (2 azimuths)
- ▲ ANL 26 in KRB
- ● ANL 20 in T-114
- ◖ SWRI 28 in (3 azimuths)
- ——— Structural Integrity Curves Used in Analysis

FIGURE 3-1 RESIDUAL STRESS CURVES USED IN ANALYSIS AND SUPPORTING EXPERIMENTAL DATA

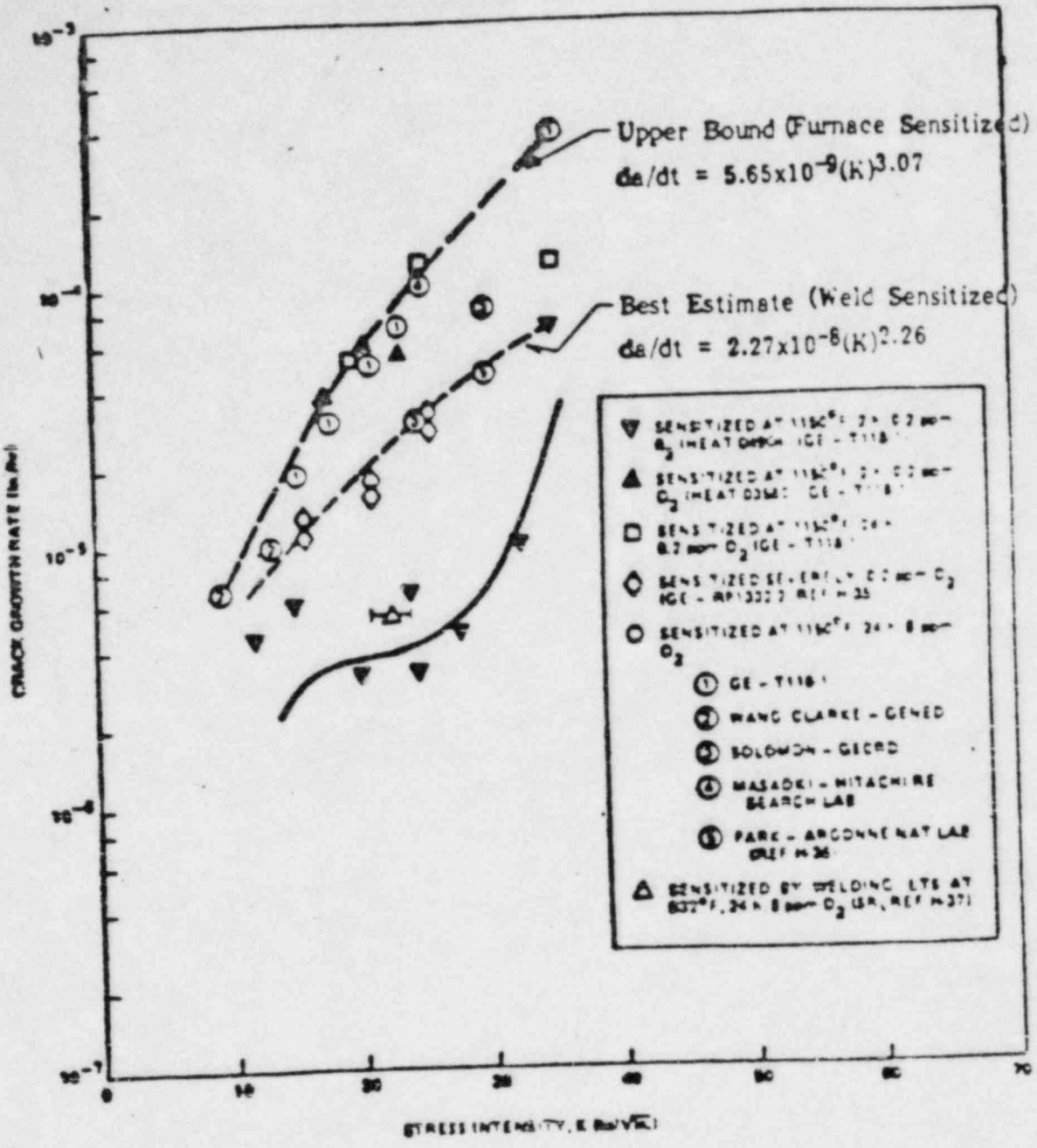


FIGURE 3-2 CRACK GROWTH RATE CURVES USED IN ANALYSIS AND SUPPORTING DATA (FROM EPRI NP-2472)

1984 WELD OVERLAY REPAIRS

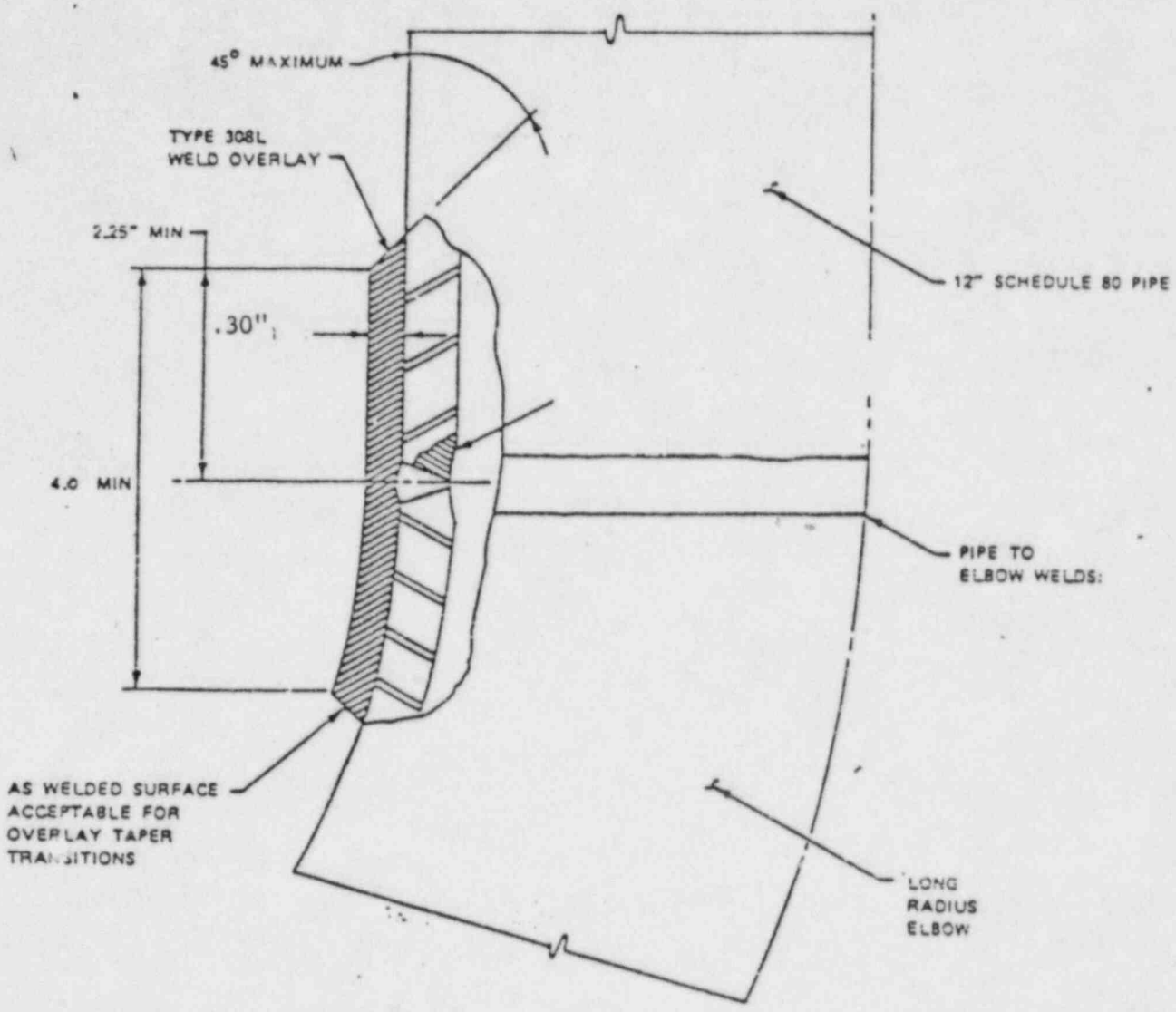
- WELD JOINT 32
  - AS REPORTED TO NRC IN OCTOBER 1983 AND MARCH 1984, 21 OF 22 OVERLAYS APPLIED AT 1983 REFUELING ON 12 INCH RISER JOINTS ARE STRUCTURAL OVERLAYS (TYPE 1).
  - WELD JOINT 32 HAD A MINI OVERLAY (T=0.15 INCH).
  - AN ADDITIONAL 0.15 INCH OF OVERLAY WELD METAL ADDED AT 1984 REFUELING RESULTING IN A TOTAL THICKNESS OF 0.3 INCH OR $0.6T_{MIN}$. (FIGURE 3-3)
  - ALL RISER OVERLAYS ARE NOW STRUCTUAL.
  - WELD METAL; 308L WITH FERRITE > 12%.
  - OVERLAY DESIGN METHODS WERE DESCRIBED IN OUR LETTERS DATED 3-13-84 AND 5-15-84.
- WELD JOINT RHR-32-4 (20 INCH)
  - ONE AXIAL INDICATION DETECTED IN THIS JOINT.
  - AN OVERLAY IS NECESSARY SINCE TENSILE THRU WALL RESIDUAL STRESS DISTRIBUTION RESULTS IN SIGNIFICANT THRU WALL GROWTH.
  - AXIAL FLAWS EXTEND WIDTH OF HEAT AFFECTED ZONE (ABOUT 0.125 TO 0.25 INCH).

- ANALYSIS PERFORMED TO VERIFY STRUCTURAL INTEGRITY OF THIS JOINT ASSUMING A THRU WALL AXIAL FLAW.

  APPLIED IWB-3640 SOURCE EQUATIONS FOR HOOP STRESS AT FAILURE.

  CAN TOLERATE A THRU WALL AXIAL FLAW OF LENGTH 5.72 INCH AND STILL MAINTAIN A SAFETY FACTOR OF 3.0.

- RESULT: APPLY THIN OVERLAY TO RETARD CRACK GROWTH AND PROVIDE BARRIER AGAINST LEAKAGE. (FIGURE 3-4).
  FINAL THICKNESS = 3/16 INCH.

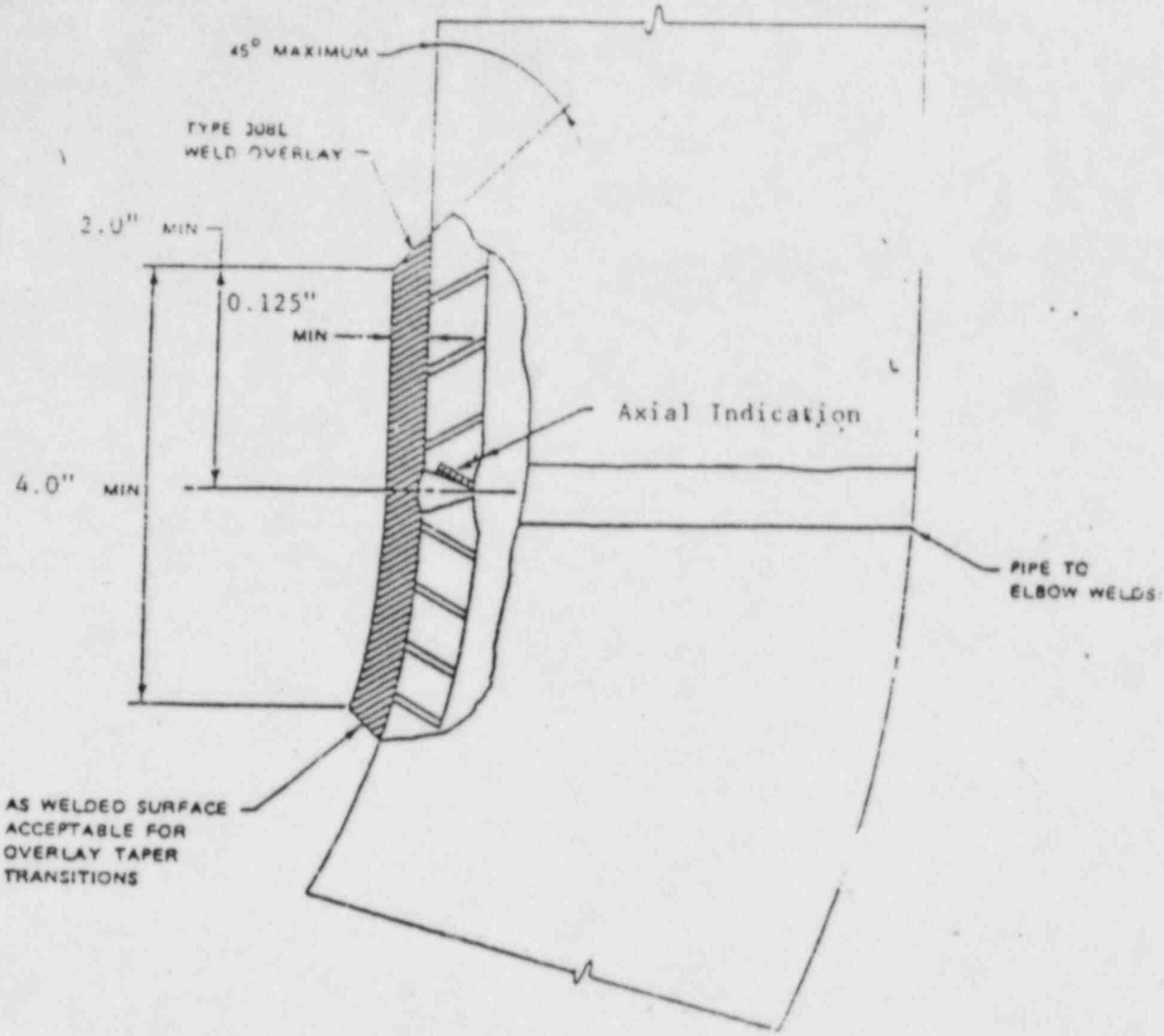


SCHEMATIC OF 12" ELBOW TO PIPE WELD OVERLAY

JOINT 32

YANKEE ATOMIC ELECTRIC COMPANY
BY REW REVISION NO. 0
BY JRH PAGE ___ OF ___

EDCR 84-405 ECN 2
ENCLOSURE F
PAGE 4 OF 4



YANKEE ATOMIC ELECTRIC COMPANY
PREPARED BY REW Revision No. 0
REVIEWED BY

Weld Joint RHR-32-4 PIPE TO ELBOW OVERLAY

F-4

RESULTS

- ALL WELD JOINTS WITH CIRCUMFERENTIAL INDICATIONS ARE ADEQUATE FOR ANOTHER CYCLE OF OPERATION.

- ONE JOINT WITH AN AXIAL INDICATION WAS OVERLAY REPAIRED.

- OVERLAYS APPLIED IN 1983 ADEQUATE FOR ONE ADDITIONAL OPERATING CYCLE.

TEARING INSTABILITY ANALYSIS

- Submitted for additional information.
- Undertaken when low toughness sub-arc weld metal concern arose.
- Analysis utilizes lower bound toughness data at all shop welds.
- Analyses illustrates large conservatism in Vermont Yankee piping arrangement.
- This evaluation is not intended as a primary safety analyses for system integrity but serves as backup for limit load analysis technique.

CRITERIA

DEMONSTRATE VERMONT YANKEE RECIRCULATION PIPING

MEETS USNRC CRITERIA FOR ALLEVIATING BREAK POSTULATION.

ALSO DEMONSTRATE ADDITIONAL CONSERVATISM.

BY SATISFYING

LEAK-BEFORE-BREAK CRITERIA

STRUCTURAL DUCTILITY CRITERIA

REF. FPDC REPORT 84-345

LEAK-BEFORE-BREAK

- LEAK RATE

  USE NORMAL OPERATING CONDITIONS.

  DETERMINE CRACK LENGTH (2c) FOR 1 AND 10 GPM LEAKAGE.

  LONGITUDINAL & CIRCUMFERENTIAL CRACK ORIENTATIONS CONSIDERED.

- CRACK STABILITY

  SHOW 2c + 2t LENGTH STABLE UNDER ASME LEVEL D LOADS.

  $J_{APP} < J_{IC}$ (FRACTURE TOUGHNESS; FOR CIRC & LONG. ORIENT.)

  $J_{APP} < J_{PZIF}$ (PLASTIC ZONE INSTABILITY; LONG. ORIENT. ONLY)

- CONSERVATISMS

  USED ONLY PRESSURE STRESS FOR LEAK RATE CALCULATIONS

  JAPP BASED ON LARGEST VALUES OF STRESSES IN PIPING SEGMENT.

  (SUCT, DISCH, HEAD, RISER)

REF. FPDC REPORT 84-345

STRUCTURAL DUCTILITY CRITERIA

ASSUMPTIONS

Supports

- o Snubbers/Hangers Ineffective
- o Existing Pipe-Whip restraints effective

Loads

- o Thermal + Pressure + Inertial Seismic
- o Use structural ductility method (SDM) for inertial.
- o Inertial loads computed by SDM "Bound" those determined by conventional modal analysis.

Crack Lengths

- o Circumferential thru-wall
- o 60 & 120^{o} Lengths
- o Much longer than lengths which produce 10 GPM

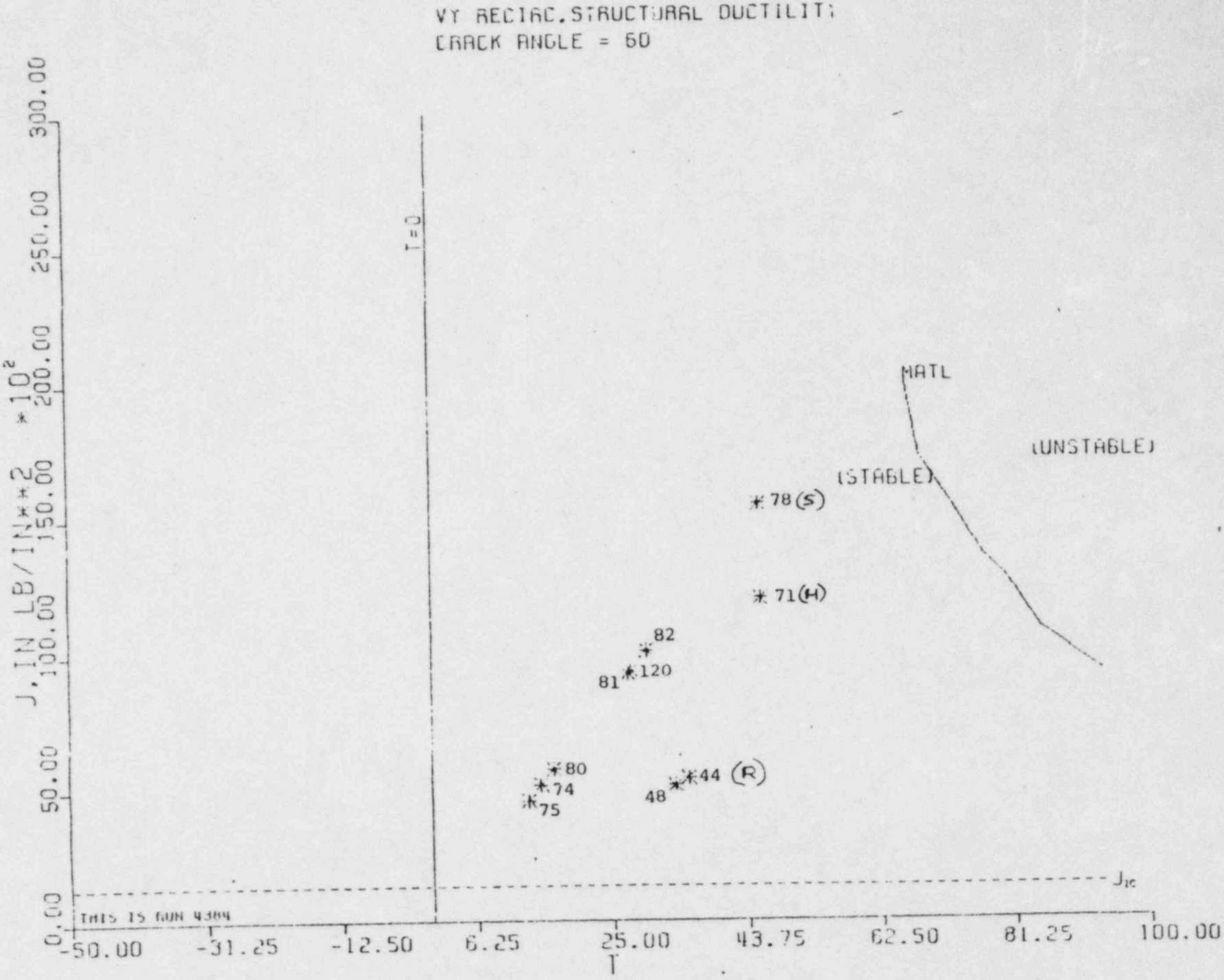
Crack Stability

- o Japp > J_{IC}; use tearing stability

RESULTS

Showed large margins of safety for all recirculation loop piping segments,

Ref. FPDC Report 84-346


VY RECIRC. STRUCTURAL DUCTILITY
CRACK ANGLE = 60
J, IN LB/IN**2 *10²
300.00
250.00
200.00
150.00
100.00
50.00
0.00
T=0
MATL
(UNSTABLE)
(STABLE)
78 (S)
71 (H)
82
81
120
80
74
75
48
44 (R)
J_{IC}
THIS IS RUN 4384
-50.00
-31.25
-12.50
6.25
25.00
43.75
62.50
81.25
100.00
T

AUGMENTED INSPECTIONS

- FLAW INDICATIONS RESULTED IN SAMPLE EXPANSION.
- ONE WELD (17B) WAS FOUND TO HAVE MINOR FLAW INDICATIONS (OUT OF A SAMPLE OF FIVE IN THE SECOND SAMPLE.)
- GL 84-11 REQUIRED 100 PER CENT INSPECTION OF REMAINING 28 INCH WELDS (TOTAL OF 13 ADDITIONAL WELDS)
- AN ADDITIONAL 13 28 INCH WELDS WOULD MORE THAN DOUBLE THE EXPOSURE.
- SUFFICIENT INSPECTORS WITH RESERVE EXPOSURE WERE NOT AVAILABLE.
- VERMONT YANKEE OFFERED TO INSPECT AN ADDITIONAL FIVE WELDS.
- BASIS FOR WELD INSPECTION WAS TO ENSURE THAT AT LEAST ONE OF EVERY SUSCEPTIBLE WELD WAS INSPECTED. ALSO, "MIRROR IMAGES" OF FLAWED WELDS WERE SELECTED.

RESULTS

- One weld (6) had a 3 inch long circumferential indication.
- Mirror Image of 59 which was inspected in 1984.
- Indication in weld 6 smaller than weld 59.

SAFETY BASIS FOR DECISION

- INSPECTION RESULTS IN BOTH SAMPLES OF 5 28 INCH WELDS ARE CONSISTENT WITH PREVIOUS INSPECTION SAMPLE.
- MAXIMUM TOTAL FLAW LENGTH IN ANY WELD IS LESS THAN 27 PER CENT OF CIRCUMFERENCE.
- LIMIT LOAD ANALYSIS WOULD ALLOW A THRU-WALL FLAW.
- REDUCED IWB-3640 LIMITS WOULD ALLOW A FLAW DEPTH IN EXCESS OF 40 PER CENT OF WALL.
- MAXIMUM OBSERVED FLAW DEPTH WELL BELOW 40 PER CENT.
- MAXIMUM OBSERVED FLAW DEPTH ACCEPTABLE FOR A FLAW IN EXCESS OF 360 DEGREES.

COMPENSATORY MEASURES

- INSTALL MOISTURE SENSITIVE TAPE TO MONITOR 8 REMAINING UNINSPECTED 28 INCH WELDS.
- CONTINUE MORE STRINGENT UNIDENTIFIED LEAKAGE LIMIT OF 2 GPM.
- TEARING STABILITY ANALYSIS DEMONSTRATED THAT IN EXCESS OF 10 GPM LEAKAGE WOULD BE REQUIRED BEFORE ANY INSTABILITY WOULD DEVELOP.
- IF WE ASSUME THAT THE FLASHING LEAKAGE IS NOT ACCOUNTED FOR IN THE UNIDENTIFIED LEAKAGE, SYSTEM LEAKAGE WOULD BE 4 GPM AT THE ACTION LIMIT.
- THIS PROVIDES A MARGIN IN EXCESS OF 2 1/2 TO THE STABILITY LIMIT.
- IN ACTUALITY, VY CHECKS FOR AN INCREASE IN EQUIPMENT DRAIN SUMPS WHEN UNIDENTIFIED LEAKAGE IS DETECTED. THUS, ACTUAL MARGIN GREATER THAN 2 1/2.

LONG TERM PLANS

- REPLACEMENT OF RECIRCULATION AND RHR SYSTEM STAINLESS STEEL PIPING IN 1985.
- SEAMLESS, LOW CARBON, CONTROLLED CHEMISTRY 316 STAINLESS STEEL WILL BE USED.
- SURVEY OF REACTOR VESSEL CONDUCTED
  - ALL FURNACE SENSITIZED SAFE ENDS REPLACED IN 1970.
  - REPLACEMENT SAFE ENDS WERE 304 LOW CARBON FORGINGS.
  - NOZZLE TO SAFE END WELDS RE-BUTTERED WITH 308L PRIOR TO SAFE END REPLACEMENT.
- CORE SPRAY MITIGATED UP TO FIRST ISOLATION VALVE.
- CRD LINE CUT AND CAPPED.
- SYSTEM SURVEY BEING CONDUCTED TO ASSESS OTHER POTENTIALLY SUSCEPTIBLE PIPING.

SUMMARY AND CONCLUSIONS

- THE 1984 INSPECTION RESULTED IN THE CONFIRMATION OF 7 OF 12 PREVIOUSLY IDENTIFIED, UNREPAIRED FLAWS AND THE DISCOVERY OF 8 NEW CIRCUMFERENTIAL FLAWS. FINITE FLAW LENGTHS WERE OBTAINED ON ALL WELDS, AND WERE SUBSTANTIALLY LESS THAN 1983 RESULTS. FLAW DEPTHS, MEASURED WITH IMPROVED SIZING TECHNIQUES, WERE SLIGHTLY GREATER FOR THE 7 PREVIOUSLY IDENTIFIED FLAWS AND EQUIVALENT IN DEPTH FOR THE 8 NEW FLAWS. ONE NEW AXIAL FLAW >10% TWD IN DEPTH WAS OVERLAY REPAIRED. IN ADDITION, THE ONE ~~SWEEP-O-LET TO~~ RISER WELD WHICH ORIGINALLY HAD A MINI-OVERLAY HAS BEEN BUILT UP TO STRUCTURAL THICKNESS.

- APPROXIMATELY 90% (69 of 77) OF THE EXAMINATIONS SPECIFIED BY THE SAMPLE SELECTION AND EXPANSION CRITERIA OF GL 84-11 WERE COMPLETED, AND APPROXIMATELY 23% (16 of 69) OF THE WELDS EXAMINED WERE FOUND TO BE FLAWED. IN CONTRAST, THE 1983 INSPECTION INCLUDED APPROXIMATELY 51% (58 of 113) OF ALL SUSCEPTIBLE REACTOR COOLANT PIPING WELDS, AND NEARLY 59% (34 of 58) OF THE WELDS EXAMINED CONTAINED INDICATIONS OF CRACKING.

- THE MORE PRECISE FLAW LENGTH AND DEPTH MEASUREMENTS ACHIEVED IN 1984 INDICATE THAT THE FLAWS ARE RELATIVELY SHORT AND SHALLOW. CONSERVATIVE ANALYSIS HAS DETERMINED THAT NONE ARE PREDICTED TO GO THROUGH WALL DURING ONE OPERATING CYCLE.

- 17 OF 22 OVERLAYS APPLIED DURING 1983 WERE RE-EXAMINED AND FOUND TO BE STILL ACCEPTABLE AFTER ONE CYCLE OF OPERATION.

- THE 1984 INSPECTION WAS THOROUGH AND CONSERVATIVE. THE EXAMINATION AND FLAW SIZING TECHNIQUES, UT EQUIPMENT, AND NDE PERSONNEL PERFORMING DATA ANALYSIS, DISCRIMINATION AND FLAW SIZING WERE DEMONSTRATED AS QUALIFIED AT THE EPRI NDE CENTER, AND ANALYTICAL METHODS WERE MORE CONSERVATIVE THAN THOSE CONTAINED IN CURRENT NRC REQUIREMENTS. INCREASED SAMPLING WAS PERFORMED FOR ALL PIPE SIZES FOUND TO CONTAIN NEW FLAWS.

- LOCAL LEAK DETECTION (MOISTURE SENSITIVE TAPE) IS BEING INSTALLED AT 6 LOCATIONS TO PROVIDE CONTINUOUS LEAKAGE MONITORING FOR THE 8 REMAINING UNINSPECTED 28" FLD JOINTS.

- TIGHTENED REACTOR COOLANT LEAKAGE LIMITS WILL REMAIN IN PLACE, CONSISTENT WITH GL 84-11 ATTACHMENT A.

- ALL REACTOR RECIRCULATION PIPING AND STAINLESS STEEL RESIDUAL HEAT REMOVAL PIPING WILL BE REPLACED WITH SEAMLESS 316 NUCLEAR GRADE PIPING DURING THE 1985 REFUELING OUTAGE. CONSIDERATION IS ALSO BEING GIVEN TO REPLACEMENT OF NON-SUSCEPTIBLE STAINLESS STEEL CORE SPRAY AND VESSEL BOTTOM HEAD DRAIN PIPING. OTHER SUSCEPTIBLE STAINLESS STEEL PIPING IN REACTOR WATER CLEANUP, CORE SPRAY, RECIRCULATION BYPASS, AND CONTROL ROD DRIVE RETURN SYSTEMS HAS ALREADY BEEN REPLACED OR REMOVED.

- BASED ON THE ABOVE, WE CONSIDER PLANT OPERATION THROUGH THE 1984/85 OPERATING CYCLE TO BE JUSTIFIED.

ENCLOSURE 2

ATTENDANCE LIST

Name	Affiliation
Vernon L. Rooney	NRR/DL/ORB#2
Robert E. White	Yankee Atomic
Andrew C. Kadak	Yankee Atomic
John R. Hoffman	Yankee Atomic
James Pelletier	Vermont Yankee
Richard D. Pagodin	Vermont Yankee
Wayne M. Linburger	Vermont Yankee
Robert D. Stout	Consultant, State of Vermont
Warren P. Murphy	Vermont Yankee
Warren S. Hazelton	NRR/DE/MTEB
Lawrence E. Mullins	Yankee Atomic Electric Co.
Robert A. McBrearty	NRC/Region I
Domenic B. Vassallo	NRR/DL/ORB#2
William V. Johnston	NRR/DE/MCET
Morton B. Fairtile	NRR/DL/ORAB
William H. Koo	NRR/DE/MTEB
Mike Lamastra	NRR/DSI/RAB
O. D. T. Lynch, Jr.	NRR/DSI/RAB
Frank C. Skopec	NRR/DSI/RAB
C. Y. Cheng	NRR/DE/MTGB
M. R. Hum	NRR/DE/MTEB
Gary Holahan	NRR/DL/ORAB
Gus Lainas	NRR/DL/OR
B. D. Liaw	NRR/DE/MEB