



Northern States Power Company

Prairie Island Nuclear Generating Plant

1717 Wagonade Dr. East
Welch, Minnesota 55089

December 30, 1994

10 CFR Part 50
Section 50.55a

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Steam Generator Weld Indication Evaluation

During the Unit 1 refueling outage in Spring 1994, ultrasonic examinations of the steam generators were performed in accordance with ASME Boiler and Pressure Vessel Code Section XI. Examinations were done to satisfy the third period requirements of the second ten-year interval and the first period requirements of the third ten-year interval. The second ten-year interval plan for Prairie Island was written to conform to the 1980 edition of ASME Section XI, with addenda through the winter of 1981. The third ten-year interval plan for Prairie Island was written to conform to the 1989 edition of ASME Section XI.

During the examinations, an indication was identified in the upper shell to dome weld region of #11 Steam Generator (see attached cover sheets to examination reports #94-0095 and 94-0096) and indications were identified in the tubesheet to channel head weld region for #12 steam generator (see attached cover sheets to examination reports #94-0218, 94-0219, and 94-0220). These indications exceed the allowable flaw size when evaluated against the standards provided in ASME Section XI, IWB-3500. Accordingly, we performed an analytical evaluation of each of these flaws per ASME Section XI, IWB-3610. Both flaws were found acceptable per these analyses. Attached for your review are the results of these evaluations. The procedure used for these evaluations are available for review.

The evaluations were performed prior to the unit startup following the refueling but we just recently became aware of the Code requirement for approval by the regulatory authority having jurisdiction at the site (in our case, the Nuclear Regulatory Commission). We regret the untimely submittal of these evaluations.

Additionally, we are currently reviewing our previous flaw evaluations to determine if there were others which would have required Nuclear Regulatory

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USNRC
December 30, 1994
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NORTHERN STATES POWER COMPANY

Commission approval. Accordingly, we will complete this review by January 31, 1995 and submit any required evaluations for your approval at that time.

Please contact Jack Leveille (612-388-1121, Ext. 4662) if you have any questions related to this letter.

Jack Leveille for

Roger O Anderson
Director
Licensing and Management Issues

c: Regional Administrator - Region III, NRC
Senior Resident Inspector, NRC
NRR Project Manager, NRC
J E Silberg

Attachments:

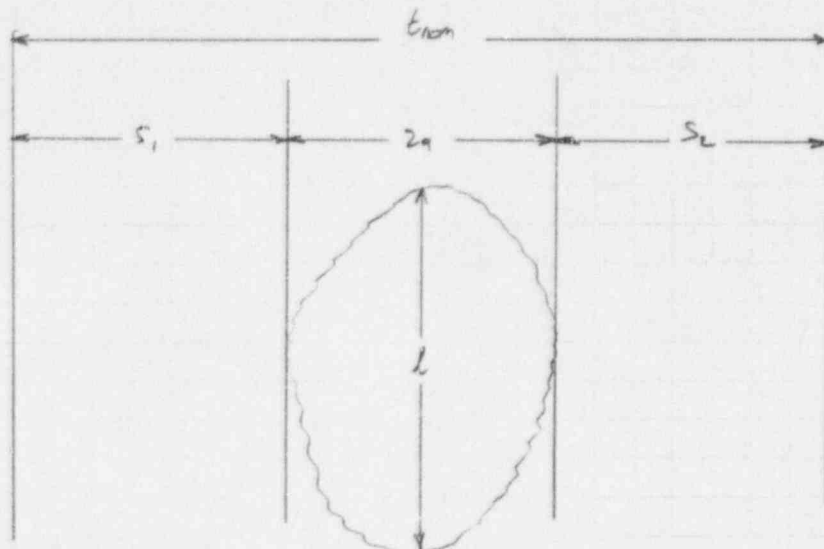
1. Ultrasonic Examination Report #94-0095 (cover sheet)
2. NSP Flaw Evaluation: 1994 PI Unit 1 ISI Program / ISI 3rd 10-yr Report 94-0095 Flaw Acceptability per WCAP 13032
3. Ultrasonic Examination Report #94-0096 (cover sheet)
4. Westinghouse ASME Section XI Flaw Evaluation, Prairie Island Unit 1 Steam Generator 12[11], Upper Shell to Dome Indication (three pages)
5. Ultrasonic Examination Report #94-0218 (cover sheet)
6. Ultrasonic Examination Report #94-0219 (cover sheet)
7. Ultrasonic Examination Report #94-0220 (cover sheet)
8. Westinghouse ASME Section XI Flaw Evaluation, Prairie Island Unit 1 Steam Generator 12, Tubesheet - Channel Head Indications (four pages)

Northern States Power Company Operations & Maintenance Supt Materials & Special Processes				Prairie Island Unit 1 60" ULTRASONIC EXAMINATION REPORT (3rd 10yr)				Report# 94-0095 Source Doc=C 1. 20 S/N 1075	
System STEAM GENERATOR #11		ISO ISI-43A		Item W-H		Item Description TOP HEAD - SHELL			
Material SA-533GAC2 / SA-533GAC2		Size/Length 175"ø		Thick/Dia 3.620		Temp 90°F		Surface Condition BLENDED	
Procedure ISI-UT-3 Rev 5 Field Change N/A				W R Number 9402190		ISI Contractor LMT		Exam Date 05/14/94	
Calibration Report Nmbr WLT-007		Beam Angle 60° (Nominal)		Temp Gauge S/N NSP-035		Exam Start @ 1320 hours Exam End @ 1445 hours			
Evaluation Level 20% DAC		Reporting Level 20% DAC		Cal Block Ref Std 26 LMT-107		Ref Sensitivity 58 dB Scan Sensitivity 76 dB			
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple GEO = Geometry Visual = Non-Section XI Visual Examination									
Scan Nmbr	Res- ults	Indication Type	Sweep Loc'n	Metal Path	Surf Dist	Circ Location	Axial Location	Indication Length	Amp %DAC
1	IND	L	4.0	3.39	2.93	13'7"	2.3	7"	40%
2	NAD								
3	NAD								
4	NAD								
LIMITATIONS: 2"x2" WELDED PADS @ 6", 176", 29', 40'4" ALL DOWNSTREAM.									
REMARKS: E.J. PAVLIC, LEVEL I <i>Indication reviewed and found acceptable.</i> <i>refer to attach #1</i> PREVIOUS INDICATIONS WERE FOUND @ <20% DAC, <i>WLT 1.741 cm 6/3/94</i> <i>refer to Attachment #2</i> <i>Mke 6.24.94</i>									
SKETCH 						PERSONNEL Examiner: <i>E.J. Pavlic</i> II Level Examiner: <i>W.L. Thomas</i> II Level Contractor Review: <i>A. White</i> 6/2/94 Date NSP Review: <i>[Signature]</i> 6/7/94 Date ANII Review: <i>[Signature]</i> 6/26/94 Date			

PROJECT 1994 PI UNIT I ISI Program

E NO. _____
SHEET NO 1 OF 2
DATE _____
COMP BY _____ C'K'D BY _____

SUBJECT ISI 2nd 10-YR ReArt 94-0095 FLAW ACCEPTABILITY
Per WCAP 13032



$$t_{nom} = 3.62$$

FROM 94-0095 Page 4 & 5:

$$\text{FORWARD MP} = 2.873$$

$$\text{BACKWARD MP} = 3.598$$

$$S_1 = 2.873 \cos 60^\circ \\ = 1.4365$$

$$S_1 + 2a = 3.598 \cos 60^\circ \\ = 1.799$$

$$2a = (S_1 + 2a) - S_1 \\ = 1.799 - 1.4365$$

$$2a = 0.3625 \rightarrow a = 0.1813 \text{ Round to } 0.18 \text{ per JWA 1200(a)}$$

$$S_2 = t_{nom} - (S_1 + 2a) \\ = 3.62 - 1.799 \\ = 1.82$$

FROM Page 94-0095 page 1 of 3

$$\text{Indicatus length } L = 7"$$

Attachment #2
Page 1 of 3

PROJECT 1994 PE Unit I ISI Program

E NO. _____

SHEET NO. _____ OF _____

SUBJECT ISI 3rd 10-yr Report 94-0095 FPAW Acceptability
per WCAP 13032

DATE _____

COMP. BY _____ C'K'D BY _____

$$\frac{q}{t} = \frac{0.18}{3.62} = 0.050$$

$$f = S + q \quad \text{per WCAP 13032 Figure 6-3.}$$

$$\text{using } S_1 = 1.4365$$

$$\text{using } S_2 = 1.82$$

$$f_1 = 1.4365 + 0.18$$

$$f_2 = 1.82 + 0.18$$

$$f_1 = 1.6165$$

RPP 42794

$$f_2 = 2.00$$

$$\left(\frac{f}{t}\right)_1 = \frac{1.165}{3.62} = \frac{1.6165}{3.62} = 0.447$$

$$\left(\frac{f}{t}\right)_2 = \frac{2.00}{3.62}$$

$$\left(\frac{f}{t}\right)_1 = 0.447$$

$$\left(\frac{f}{t}\right)_2 = 0.553$$

Using Figure 6-3 From WCAP 13032:

$$\left(\frac{f}{t}\right)_1 = 0.447 \quad \text{and} \quad \left(\frac{f}{t}\right)_2 = 0.553 \quad \text{are within the}$$

substantive range. (See Attached plot)

$$\frac{q}{t} = 0.050 \quad \text{is within the Acceptable range (See Attached plot).}$$

∴ Inspection on ISI Examination Report # 94-0095
is Acceptable to WCAP 13032.

Mark Lohr
MFSR Engr 24 JUNE 1994

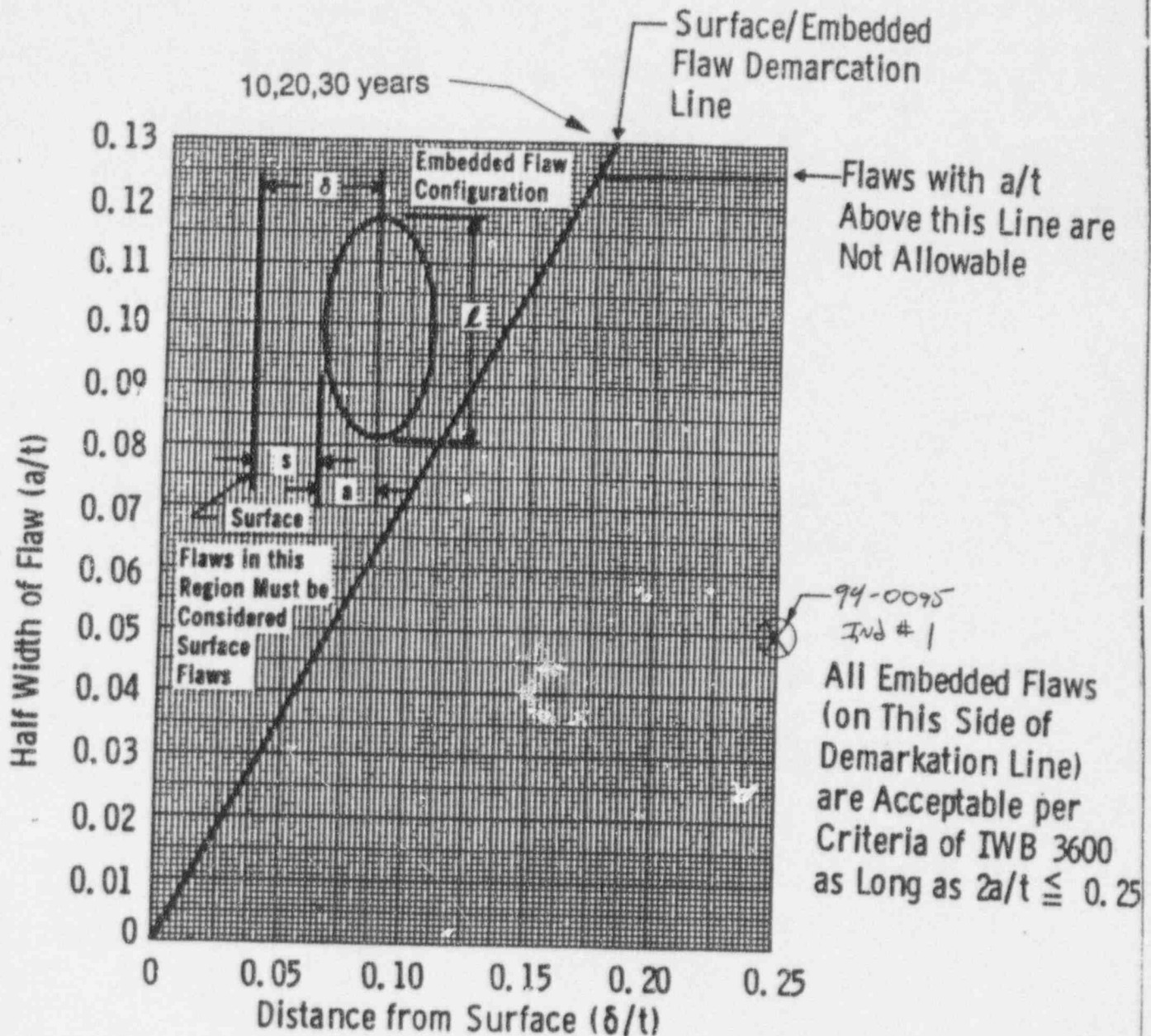


FIGURE 6-3 EMBEDDED FLAW EVALUATION CHART FOR CIRCUMFERENTIAL INDICATIONS IN THE UPPER SHELL TO DOME WELD REGION, PRAIRIE ISLAND UNITS 1 AND 2 (Note that this chart is a direct implementation of the rules of Section XI, IWB 3600.)

Northern States Power Company Operations & Maintenance Supt Materials & Special Processes		Prairie Island Unit 1 45° ULTRASONIC EXAMINATION REPORT (3rd 10yr)		Report# 94-0096 Source Doc=C 1. 20 S/N 1075	
System STEAM GENERATOR #11		ISO ISI-43A		Item W-H	
Material SA-533GAC2 / SA-533GAC2		Size/Length 175"ø		Thick/Dia 3.620	
		Temp 90°F		Item Description TOP HEAD - SHELL	
Procedure ISI-UT-3		Rev 5		Field Change N/A	
W R Number 9402190		ISI Contractor LMT		Exam Date 05/14/94	
Calibration Report Nmbr WLT-006		Beam Angle 45° (Nominal)		Temp Gauge S/N NSP-035	
Exam Start @ 0985 hours		Exam End @ 1147 hours			
Evaluation Level 20% DAC		Reporting Level 20% DAC		Cal Block 26 Ref Std LMT-107	
Ref Sensitivity 42 dB		Scan Sensitivity 60 dB			

RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nmr	Res-ults	Indication Type	Sweep Loc'n	Metal Path	Surf Dist	Circ Location	Axial Location	Indication Length	Amp %DAC
1	NAD	LINEAR	6.0	3.733	2.63	14'10"	2.85	2"	50%
2	IND								
3	NAD								
4	NAD								

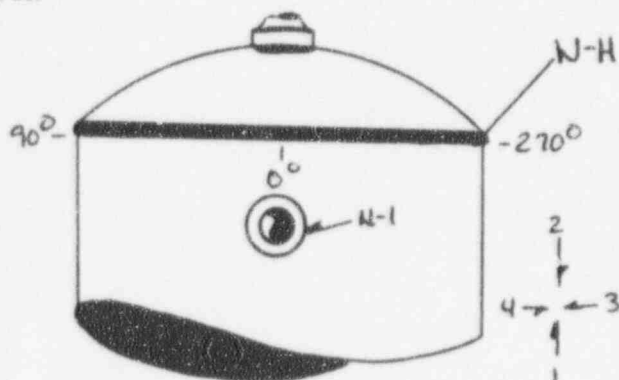
LIMITATIONS: 2"x2" WELDED PADS @ 6", 17' 6", 29', 40' 4" ALL DOWNSTREAM.

REMARKS: E.J. BAWLIC LEVEL I

PREVIOUS INDICATIONS WERE FOUND @ <20% DAC WITH 6-7-94

Indication reviewed and found acceptable. Refer to Attach #1. CH 6-24-94
See attached evaluation
6/12/94
20% 6-24-94

SKETCH



PERSONNEL

Examiner: *[Signature]* II Level
 Examiner: W.L. THOMAS II Level
 J.L. RIVERS

Contractor Review: *[Signature]* 5/24/94 Date
 NSP Review: *[Signature]* 6/12/94 Date
 ANII Review: *[Signature]* 6/12/94 Date

ASME Section XI Flaw Evaluation
Prairie Island Unit 1 Steam Generator 12
Upper Shell to Dome Indication

During the June 1994 In Service Inspection (ISI), ultrasonic examination revealed an indication in the upper shell to dome weld region of the steam generator at Prairie Island Unit 1. The dimension and sizing information were taken from Prairie Island Unit 1 45°F Ultrasonic Examination Report # 94-0096. This indication has been determined to be acceptable by analysis and is shown in Figure 1. This evaluation was based on the ASME Code Section XI criteria for acceptance of an indication by fracture mechanics analysis given in paragraph IWB-3600. The material information used to generate these charts is specific to the Prairie Island steam generators. The RT_{NDT} is 10°F for this region.

The fracture toughness of the materials in this region was determined to be on the upper shelf due to the high minimum temperature for the normal and upset transients in this region, the lowest of which is 254°F, the inservice hydrostatic test temperature applicable for 20 EFY. The upper shelf for fracture toughness has been assumed to be 200 ksi√in. This is based on the reference toughness curves found in Figure A-4200-1 of appendix A of ASME Code Section XI.

This region has been evaluated for similar flaws in the past. Ultrasonic examination revealed 3 indications in this region in 1991 in the same steam generator. The analyses for the flaws found in the 1991 inspection are documented in Reference 1. Figure 2 is the chart from reference 1 which shows the plotted indications found in 1991. The last page shows the cover page of the Reference 1 WCAP report.

References:

- 1.) WCAP 13032 - "Handbook on Flaw Evaluation - Prairie Island Units 1 and 2 Steam Generators Upper Shell to Dome Weld." S. Tandon, et al, July 1991.

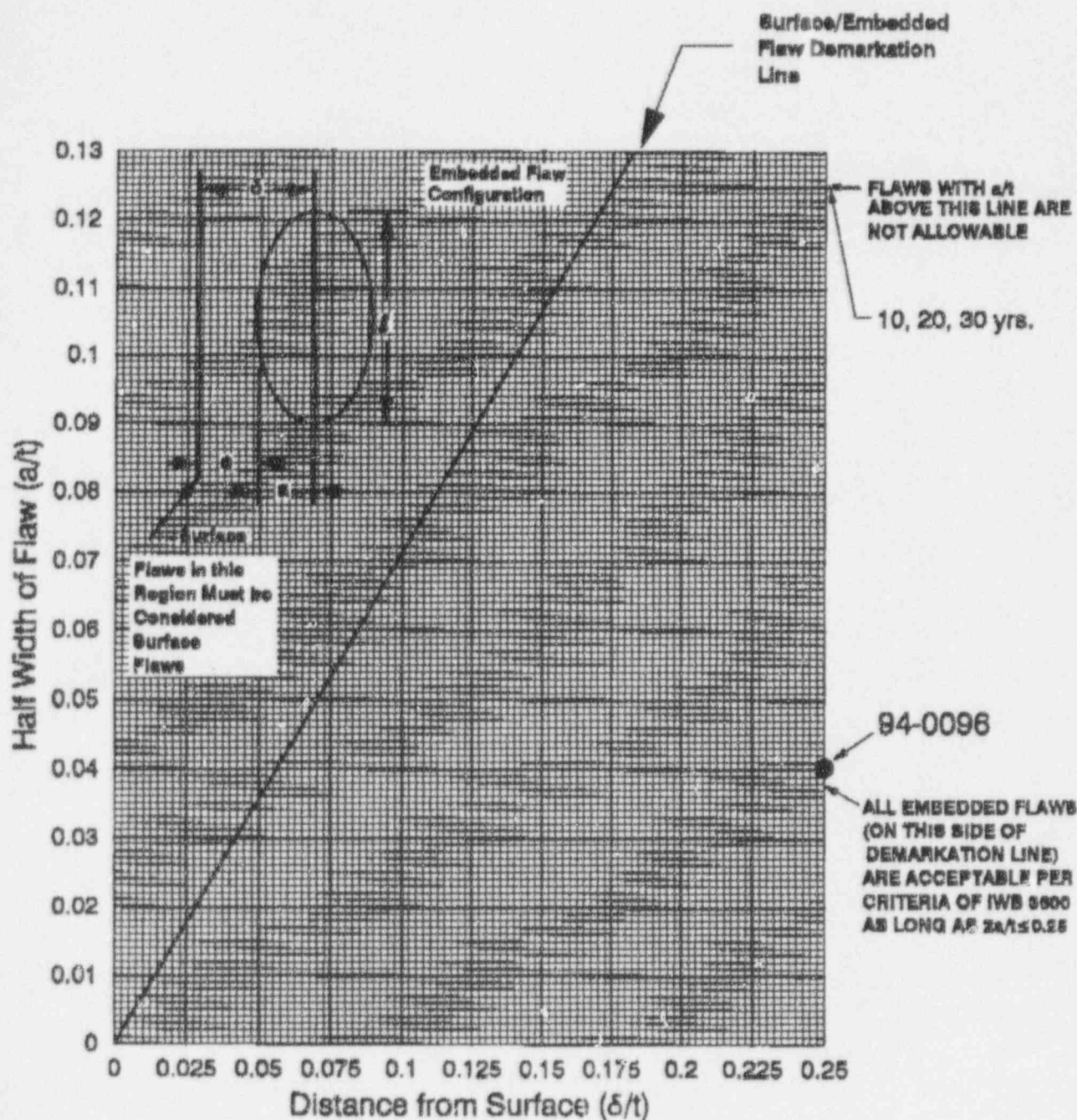


Figure 1. - Embedded Flaw Chart for the Upper Shell to Dome

Weld Region Containing Indication Found In June 1994

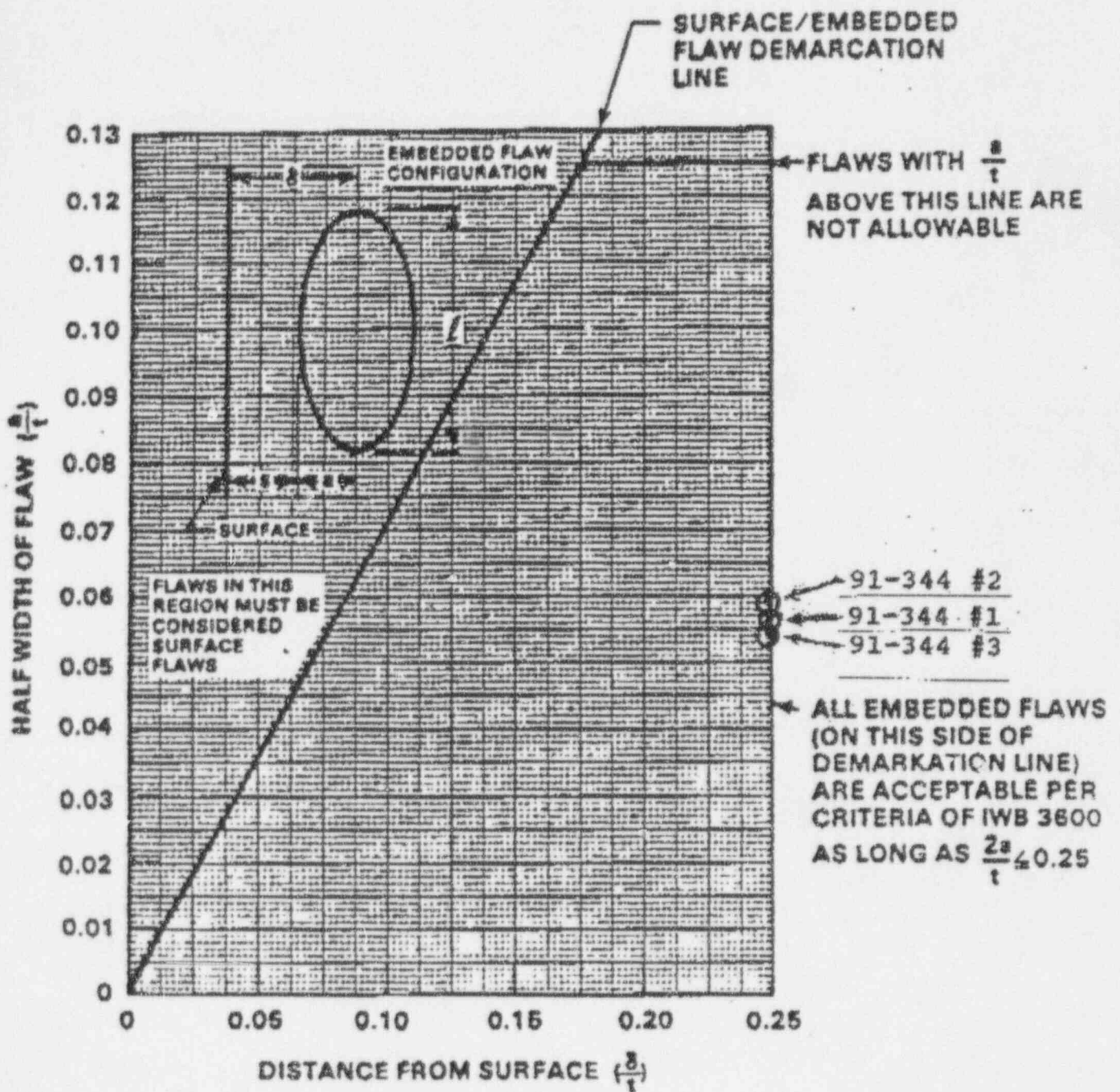


Figure 2 Results of Flaw Evaluation for the Upper Shell to Dome Region, Prairie Island Unit 1, Spring 1991

WCAP 13032

HANDBOOK ON FLAW EVALUATION
PRAIRIE ISLAND UNITS 1 AND 2 STEAM GENERATORS
UPPER SHELL TO DOME WELD REGION

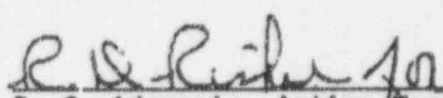
July 1991

S. Tandon
D. E. Prager
J. C. Schmertz
D. S. Drinon

Reviewed by:


W. H. Bamford

Approved by:


D. C. Adamonis, Acting Manager
Structural Mechanics Technology

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Energy Systems Division
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Pittsburgh, Pennsylvania 15230-2728
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Northern States Power Company
Operations & Maintenance Supt
Materials & Special Processes

Prairie Island Unit 1
45° ULTRASONIC EXAMINATION
REPORT (2nd 10yr)

Report# 94-0218
Source Doc=B 2. 40
S/N 1062

System STEAM GENERATOR #12		ISO ISI-43B (ISI-43)		Item W-A		Item Description TUBE SHEET / HEAD	
Material SA533GR-B / SA533GR-B		Size/Length 135"		Thick/Dia 5.160		Temp 75°F	
Surface Condition BLENDED							
Procedure ISI-UT-3		Rev 5		Field Change N/A		W R Number 9402190	
ISI Contractor LMT		Exam Date 06/07/94					
Calibration Report Nbr QL-011		Beam Angle 45° (Nominal)		Temp Gauge S/N NSP-037		Exam Start @ 0905 hours Exam End @ 1137 hours	
Evaluation Level 20% DAC		Reporting Level 20% DAC		Cal Block 25A		Ref Sensitivity 48 dB Scan Sensitivity 60 dB	
Ref Std LMT-106							

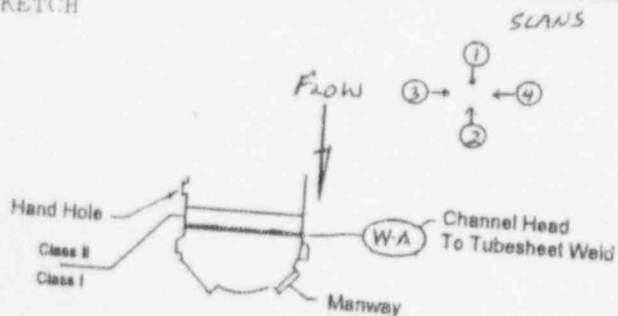
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nbr	Results	Indication Type	Sweep Loc'n	Metal Path	Surf Dist	Circ Location	Axial Location	Indication Length	Amp %DAC
1	L	LINEAR	4.5	4.215	3.25	33' 6.5"	3.049"	12.5"	75%
2	NAD								
3	NAD								
4	NAD								

LIMITATIONS: 2"x2" PADS ON U.S. AND D.S. OF WELD TOE @ 5'2", 14' 23", AND @ 32' 3".
UPSTREAM SCANS ONLY @ 11' TO 11' 6" DUE TO 6"x4" PAD.

REMARKS: EXAMINER: E.J. PAVLIC, LEVEL I

SKETCH



PERSONNEL

Examiner: B. L. L. L. II Level
Examiner: Q. LOREDO II Level
Examiner: Charles P. McElroy II Level

Contractor Review: Q. Loredo 6/10/94 Date
NSP Review: Q. Loredo 6/10/94 Date
ANII Review: Q. Loredo 6/10/94 Date

Northern States Power Company Operations & Maintenance Supt Materials & Special Processes			Prairie Island Unit 1 0* ULTRASONIC EXAMINATION REPORT (2nd 10yr)			Report# 94-0219 Source Doc=B 2. 40 S/N 1062		
System STEAM GENERATOR #12		ISO ISI-43B		Item W-A		Item Description TUBE SHEET / HEAD		
Material SA533GR-B / SA533GR-B		Size/Length 135"		Thick/Dia 5.160		Temp 75°F		Surface Condition BLENDED
Procedure ISI-UT-3 Rev 5 Field Change N/A				W R Number 9402190		ISI Contractor LMT		Exam Date 06/06/94
Calibration Report Nmbr QL-010		Beam Angle 0* (Nominal)		Temp Gauge S/N NSP-037		Exam Start @ 1245 hours Exam End @ 1430 hours		
Evaluation Level 20% DAC		Reporting Level 50% DAC		Cal Block 25A Ref Std LMT-106		Ref Sensitivity 37 dB Scan Sensitivity 49 dB		

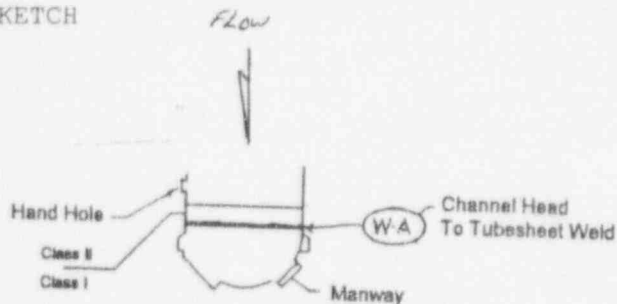
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nmbr	Res- ults	Indication Type	Sweep Loc'n	Metal Path	Surf Dist	Circ Location	Axial Location	Indication Length	Amp %DAC
L1	NAD								

LIMITATIONS: 2"x2" PADS ON U.S. AND D.S. OF WELD TOE @ 5' 2", 14', 23' AND AT 32' 3".
UPSTREAM SCANS ONLY @ 11' TO 11' 6" DUE TO 6"x4" PAD.

REMARKS: EXAMINER: E.J. PAVLIC, LEVEL I *[Signature]*

SKETCH



PERSONNEL

Examiner: *[Signature]* II Level
Examiner: *[Signature]* II Level
C.F. McELROY

Contractor Review: *[Signature]* 6/9/94 Date
NSP Review: *[Signature]* 6/10/94 Date
ANII Review: *[Signature]* 6/22/94 Date

Northern States Power Company Operations & Maintenance Supt Materials & Special Processes		Prairie Island Unit 1 60" ULTRASONIC EXAMINATION REPORT (2nd 10yr)		Report# 94-0220 Source Doc=B 2. 40 S/N 1062	
System STEAM GENERATOR #12	ISO ISI-43B (ISI-43)	Item W-A	Item Description TUBE SHEET / HEAD		
Material SA533GR-B / SA533GR-B	Size/Length 135"	Thick/Dia 5.160	Temp 75°F	Surface Condition BLENDED	
Procedure ISI-UT-3 Rev 5 Field Change N/A		W R Number 9402190	ISI Contractor LMT	Exam Date 06/07/94	
Calibration Report Nbr QL-012	Beam Angle 60° (Nominal)	Temp Gauge S/N NSP-037	Exam Start @ 1300 hours Exam End @ 1507 hours		
Evaluation Level 20% DAC	Reporting Level 20% DAC	Cal Block Ref Std 25A LMT-106	Ref Sensitivity 54 dB Scan Sensitivity 66 dB		

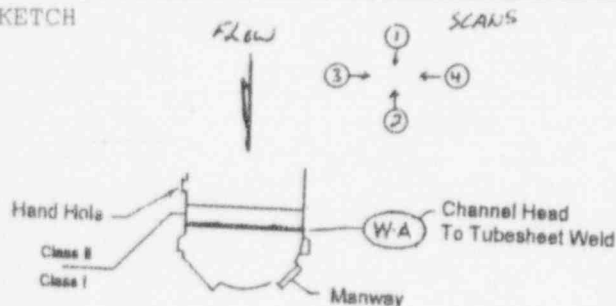
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nbr	Results	Indication Type	Sweep Loc'n	Metal Path	Surf Dist	Circ Location	Axial Location	Indication Length	Amp %DAC
1	L	LINEAR	4.7	6.302	5.00	33' 5"	6.3"	12.5"	80%
2	NAD								
3	NAD								
4	NAD								

LIMITATIONS: 2"x2" PADS ON U.S. AND D.S. OF WELD TOE @ 5' 2", 14', 23', AND AT 32' 3".
UPSTREAM SCANS ONLY @ 11' TO 11' 6" DUE TO 6" x 4" PAD.

REMARKS: EXAMINER: E.J. PAVLIC, LEVEL I

SKETCH



PERSONNEL

Examiner: P. Loredo II Level
O. LOREDO
Examiner: Charles P. McElroy II Level
C.P. McELROY

Contractor Review: [Signature] 6/10/94 Date
NSP Review: [Signature] 6/10/94 Date
ANII Review: [Signature] 6/20/94 Date

ASME Section XI Flaw Evaluation
Prairie Island Unit 1 Steam Generator 12
Tubesheet - Channel Head Indications

A fracture mechanics evaluation has been performed on the indication found during ultrasonic examinations of steam generator 12 at Prairie Island Unit 1 in June 1994. This evaluation was based on the ASME Code Section XI criteria for acceptance of an indication by fracture mechanics analysis given in paragraph IWB-3600.

Information detailing the weld dimensions was provided in three Prairie Island Ultrasonic Examination Reports; Report #'s 94 - 218, 94 - 219 and 94 - 220. These reports were provided in Reference 1. The indication was found in the tubesheet to channel head weld W-A (see Reference 1).

The result of this evaluation is a flaw evaluation chart, shown in Figure 1, which was developed to permit on-site evaluation of flaws found in the region in question during in-service inspections. The chart shows the largest acceptable flaw sizes for a range of aspect ratios as prescribed by the criteria of section XI. The chart has been constructed for a circumferential embedded flaw since this is the type of flaw which was discovered in the June inspection. The chart is based on conservative material properties with the $RT_{NDT} = 40^{\circ}\text{F}$ (RT_{NDT} for Prairie Island Unit 1 is 30°F).

The fracture toughness of the materials in this region was determined to be on the upper shelf. This is due to the high minimum temperature for the normal and upset transients in this region, the lowest of which is 254°F , the inservice hydrostatic test temperature applicable for 20 EFY. The upper shelf for fracture toughness has been assumed to be $200 \text{ ksi}\sqrt{\text{in}}$. This is based on the reference toughness curves found in Figure A-4200-1 of appendix A of ASME Code Section XI.

Crack growth analyses used in the generation of the attached flaw chart also applied the approach outlined in ASME Code Section XI and used the reference crack growth curves shown in Appendix A, Figure A 4300-1. The crack growth analysis was performed using all design basis transient cycles applicable in the tubesheet - channel head region. Results presented in the chart represent the 10, 20 and 30 year final crack sizes for these aspect ratios. The results are the same for 10, 20 and 30 years,

since the fatigue crack growth is small in this region. In this region, the flaw chart is blank, meaning that a flaw which meets the code criteria to be classified as embedded is acceptable by the analytical criteria of Section XI IWB-3600

To use the chart, three parameters are needed:

a/t : flaw depth/wall thickness

a/l : flaw depth/flaw length

δ/t : flaw surface proximity/wall thickness

where

$$\delta = S + a$$

S = distance from the flaw to the nearest surface

The parameters used to determine the point plotted on the chart are listed below:

$$a = 0.186''$$

$$t = 5.589''$$

$$l = 12.5''$$

$$S = 2.98''$$

$$\delta = 3.166''$$

$$\delta/t = 0.566 \text{ (chart limit } = 0.25)$$

$$a/t = 0.0333$$

It is easily seen from the chart that the indication in the tubesheet to channel head region found in Unit 1 is acceptable for operation by analysis.

References:

1. Letter from R. Pearson of Northern States Power to W. H. Bamford of Westinghouse Electric Corporation, Subject: Ultrasonic Exam Indications in 12 Steam Generator Tubesheet/Channel Weld.

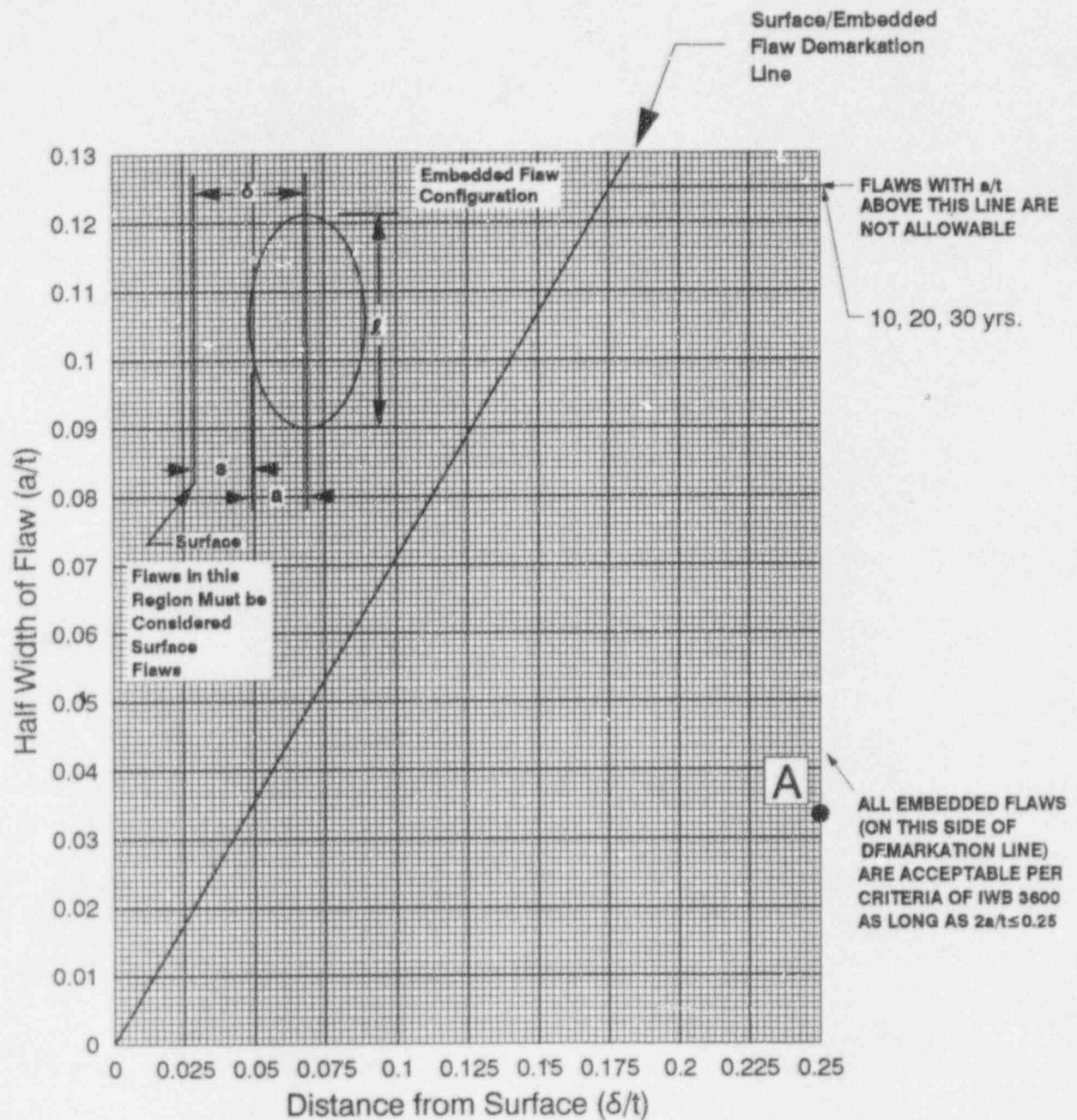


Figure 1. - Embedded Flaw Chart for the Tubesheet to Channel Head
Weld Region Containing Indication Found in June 1994