Northern States Power Company

Prairie Island Nuclear Generating Plant

1717 Wakonade 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 editi 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

A001
1/1

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	ISO	Item	Item Description
STEAM GENERATOR #11	ISI-43A	W-H	TOP HEAD - SHELL

Material	Size/Length	Thick/Dia	Temp	Surface Condition
SA-533GAC2 / SA-533GAC2	175"ø	3.620	90°F	BLENDED

Procedure	W R Number	ISI Contractor	Exam Date
ISI-UT-3 Rev 5 Field Change N/A	9402190	LMT	05/14/94

Calibration Report Nmbr	Beam Angle	Temp Gauge S/N	Exam Start / Exam End
WLT-007	60° (Nominal)	NSP-035	Exam Start @ 1320 hours Exam End @ 1445 hours

Evaluation Level	Reporting Level	Cal Block / Ref Std	Ref / Scan Sensitivity
20% DAC	20% DAC	Cal Block 26 Ref Std LMT-107	Ref Sensitivity 58 dB Scan Sensitivity 76 dB

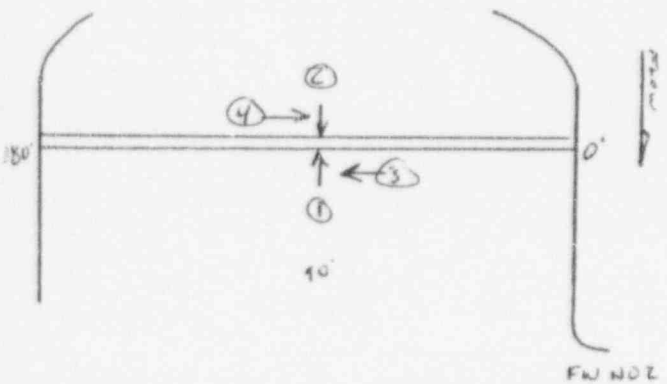
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nmbr	Results	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", 17'6", 29', 40'4" ALL DOWNSTREAM.

REMARKS: E.J. PAVLIC, LEVEL I Indication reviewed and found acceptable. refer to attach #1 refer to Attachment #2
PREVIOUS INDICATIONS WERE FOUND @ <20% DAC, RLT 6.7.94 TMS 6/13/94 MLC 6.24.94

SKETCH



PERSONNEL

Examiner: W.L. THOMAS — II Level

Examiner: J.L. DEVERS — II Level

Contractor Review: 6/2/94 Date

NSP Review: 6/7/94 Date

ANII Review: 6/26/94 Date

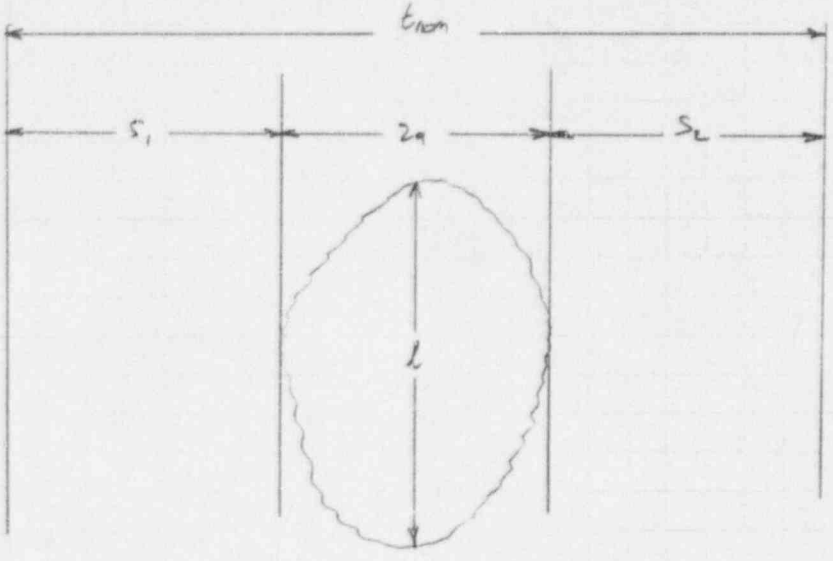
GENERAL COMPUTATION SHEET
Form 17-2494 (4-91)

Northern States Power Company

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

PROJECT 1994 PI UNIT 1 ISI Program

SUBJECT ISI 2nd 10-yr Outage 94-0095 FLAW ACCEPTABILITY
per WCAP 13032



$t_{nom} = 3.62$

From 94-0095 Page 4 of 5:

FORWARD MP = 2.873 BACKWARD MP = 3.598

$S_1 = 2.873 \cos 60°$ $S_1 + 2_q = 3.598 \cos 60°$

$= 1.4365$ $= 1.799$

$2_q = (S_1 + 2_q) - S_1$

$= 1.799 - 1.4365$

$2_q = 0.3625 \rightarrow \varphi = 0.1813$ Round to 0.18 per ASME Sec XI (9)

$S_2 = t_{nom} - (S_1 + 2_q)$

$= 3.62 - 1.799$

$= 1.82$

From Page 94-0095 Page 1 of

Indications length $l = 7"$

Attachment #2
Page 1 of 3

GENERAL COMPUTATION SHEET
Form 17-2494 (4-91)

Northern States Power Company

PROJECT 1994 PI Unit 1 ISI Program
E NO.
SHEET NO ____ OF ____
DATE
SUBJECT ISI 3rd 10-yr Report 94-0095 Flaw Acceptability per WCAP 13032
COMP. BY ____ C'K'D BY ____

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

$\delta = S + a$ per WCAP 13032 Figure 6-3.

using $S_1 = 1.4365$

$\delta_1 = 1.4365 + 0.18$

$\delta_1 = 1.6165$

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

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

using $S_2 = 1.82$

$\delta_2 = 1.82 + 0.18$

$\delta_2 = 2.00$

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

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

RPP 6-27-94

same ok

Using Figure 6-3 From WCAP 13032:

$\left(\frac{\delta}{t}\right)_1 = 0.447$ and $\left(\frac{\delta}{t}\right)_2 = 0.553$ are within the subsurface range. (See Attached plot)

$\frac{a}{t} = 0.050$ is within the Acceptable range (See Attached plot)

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

Mark Lafler
M+S Engr 24 JUNE 1994

Attachment #2
Page 2 of 3

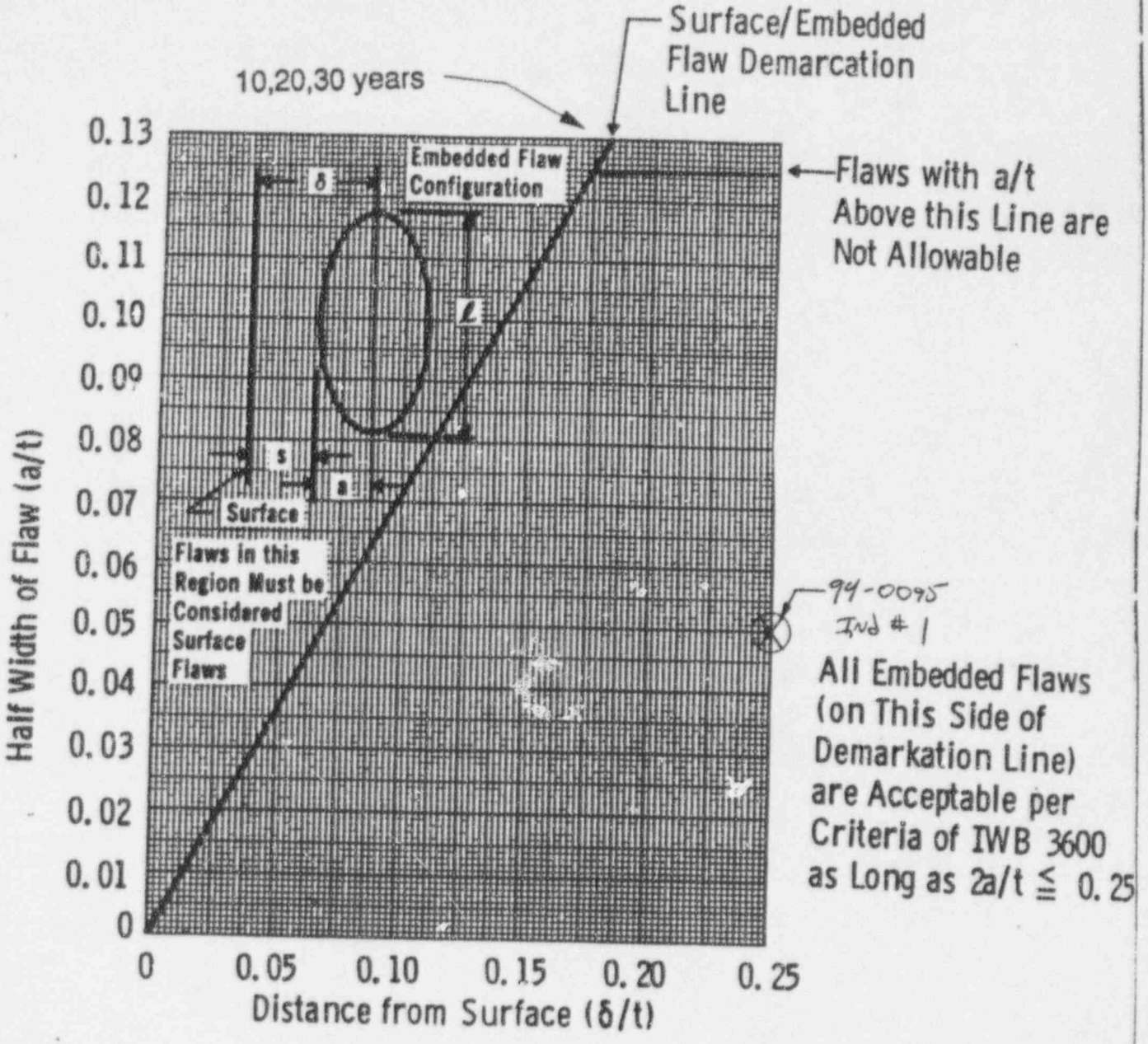


FIGURE 6-3 EMBEDDED FLAW EVALUATION CHART FOR CIRCUMFERENTIAL INDICATIONS IN THE UPPER SHELL TO DOME WELD REGION, PRAIRIE ISLAND UNITS 1 AND 2 (Note that this chart is a direct implementation of the rules of Section XI, IWB 3600.)

Attachment #2
Page 3 of 7

REPORT # _____
PAGE ____ of ____

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	ISO	Item	Item Description
STEAM GENERATOR #11	ISI-43A	W-H	TOP HEAD - SHELL

Material	Size/Length	Thick/Dia	Temp	Surface Condition
SA-533GAC2 / SA-533GAC2	175"ø	3.620	90°F	BLENDED

Procedure	W R Number	ISI Contractor	Exam Date
ISI-UT-3 Rev 5 Field Change N/A	9402190	LMT	05/14/94

Calibration Report Nmbr	Beam Angle	Temp Gauge S/N	Exam Start / Exam End
WLT-006	45° (Nominal)	NSP-035	Exam Start @ 0985 hours Exam End @ 1147 hours

Evaluation Level	Reporting Level	Cal Block / Ref Std	Ref Sensitivity / Scan Sensitivity
20% DAC	20% DAC	Cal Block 26 Ref Std LMT-107	Ref Sensitivity 42 dB Scan Sensitivity 60 dB

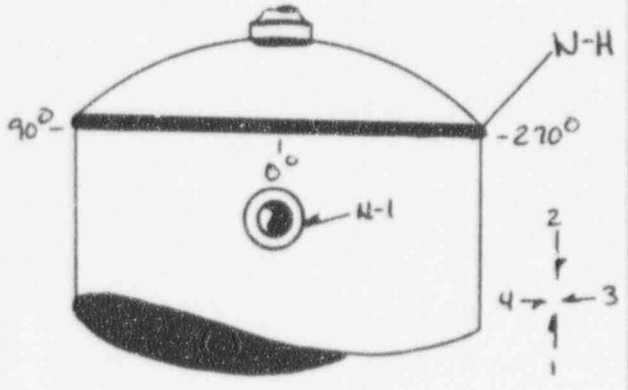
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

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

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

REMARKS: E.J. PAVLIC, LEVEL I ~~Indication reviewed and found Acceptable.~~ Refer to Attach #1. 6-24-94 See attached examination 6/13/94 6.24.94
PREVIOUS INDICATIONS WERE FOUND @ <20% DAC on 6.7.94

SKETCH



PERSONNEL

Examiner: W.L. THOMAS — II Level

Examiner: J.L. BEVERS — II Level

Contractor Review: 5/24/94 Date

NSP Review: 6/7/94 Date

ANII Review: 6/20/94 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 EFPY. The upper shelf for fracture toughness has been assumed to be 200 $ksi\sqrt{in}$. 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 sane 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 Evalaution - Prairie Island Units 1 and 2 Steam Generators Upper Shell to Dome Weld." S. Tandon, et al, July 1991.

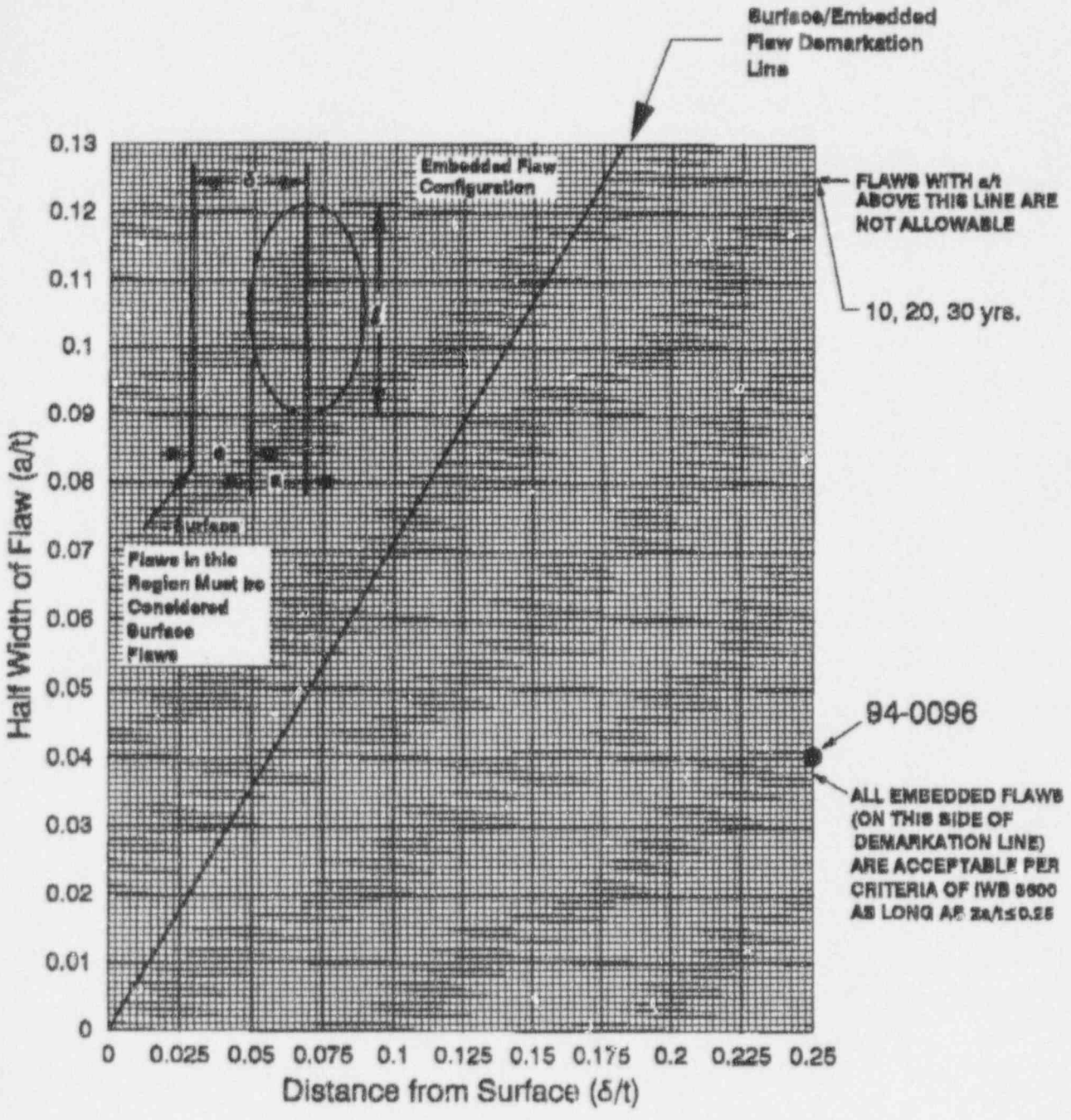


Figure 1. - Embedded Flaw Chart for the Upper Shell to Dome Weld Region Containing Indication Found In June 1994

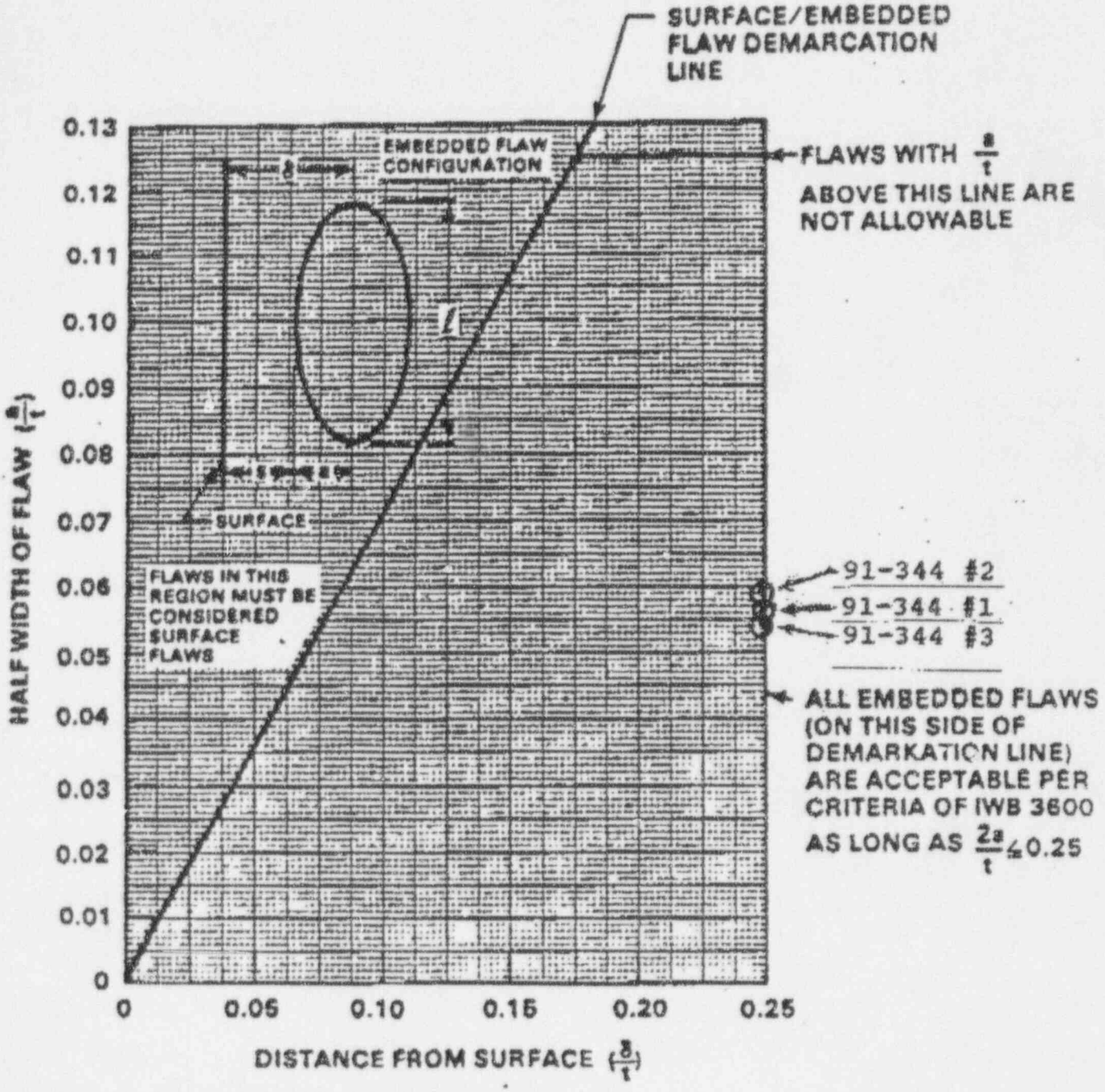


Figure 2. Results of Flaw Evaluation for the Upper Shell to Dome Region, Prairie Island Unit 1, Spring 1991

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

WESTINGHOUSE ELECTRIC CORPORATION
Energy Systems Division
P.O. Box 2728
Pittsburgh, Pennsylvania 15230-2728

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	ISO	Item	Item Description
STEAM GENERATOR #12	ISI-43B (ISI-43)	W-A	TUBE SHEET / HEAD

Material	Size/Length	Thick/Dia	Temp	Surface Condition
SA533GR.-B / SA533GR-B	135"	5.160	75°F	BLENDED

Procedure	W R Number	ISI Contractor	Exam Date
ISI-UT-3 Rev 5 Field Change N/A	9402190	LMT	06/07/94

Calibration Report Nmbr	Beam Angle	Temp Gauge S/N	Exam Start / End
QL-011	45° (Nominal)	NSP-037	Exam Start @ 0905 hours Exam End @ 1137 hours

Evaluation Level	Reporting Level	Cal Block / Ref Std	Ref / Scan Sensitivity
20% DAC	20% DAC	Cal Block 25A Ref Std LMT-106	Ref Sensitivity 48 dB Scan Sensitivity 60 dB

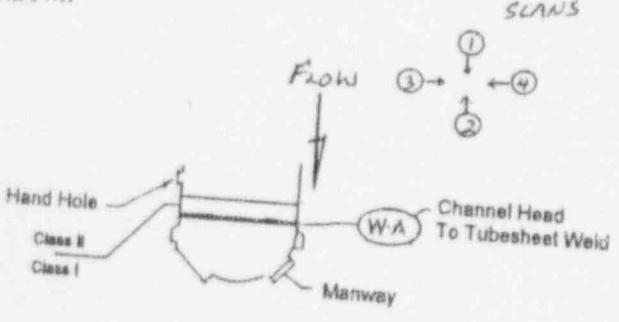
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nmbr	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: Q. LOREDO — II Level

Examiner: C.P. McELROY — II Level

Contractor Review: 6/10/94 Date

NSP Review: 6/10/94 Date

ANII Review: 6/20/94 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	ISO	Item	Item Description
STEAM GENERATOR #12	ISI-43B	W-A	TUBE SHEET / HEAD

Material	Size/Length	Thick/Dia	Temp	Surface Condition
SA533GR-B / SA533GR-B	135"	5.160	75°F	BLENDED

Procedure	W R Number	ISI Contractor	Exam Date
ISI-UT-3 Rev 5 Field Change N/A	9402190	LMT	06/06/94

Calibration Report Nmbr	Beam Angle	Temp Gauge S/N	Exam Start / End
QL-010	0° (Nominal)	NSP-037	Exam Start @ 1245 hours Exam End @ 1430 hours

Evaluation Level	Reporting Level	Cal Block / Ref Std	Ref / Scan Sensitivity
20% DAC	50% DAC	Cal Block 25A Ref Std LMT-106	Ref Sensitivity 37 dB Scan Sensitivity 49 dB

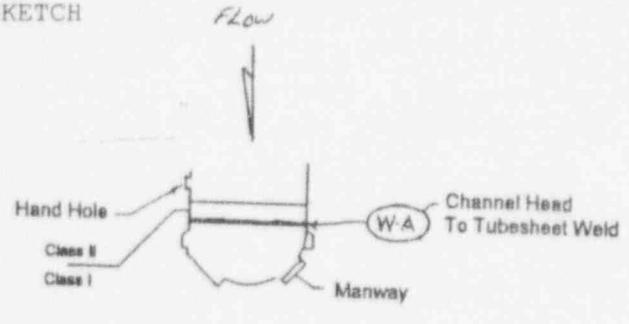
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nmbr	Results	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

SKETCH



PERSONNEL

Examiner: Q. LOREDO II Level

Examiner: C.F. McELROY II Level

Contractor Review: 6/9/94 Date

NSP Review: 6/10/94 Date

ANII Review: 6/22/94 Date

Northern States Power Company Opérations & 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	ISO	Item	Item Description
STEAM GENERATOR #12	ISI-43B (ISI-43)	W-A	TUBE SHEET / HEAD

Material	Size/Length	Thick/Dia	Temp	Surface Condition
SA533GR-B / SA533GR-B	135"	5.160	75°F	BLENDED

Procedure	W R Number	ISI Contractor	Exam Date
ISI-UT-3 Rev 5 Field Change N/A	9402190	LMT	06/07/94

Calibration	Beam Angle	Temp Gauge S/N	Exam Start @ 1300 hours
Report Nmbr QL-012	60° (Nominal)	NSP-037	Exam End @ 1507 hours

Evaluation Level	Reporting Level	Cal Block 25A Ref Std LMT-106	Ref Sensitivity 54 dB Scan Sensitivity 66 dB
20% DAC	20% DAC		

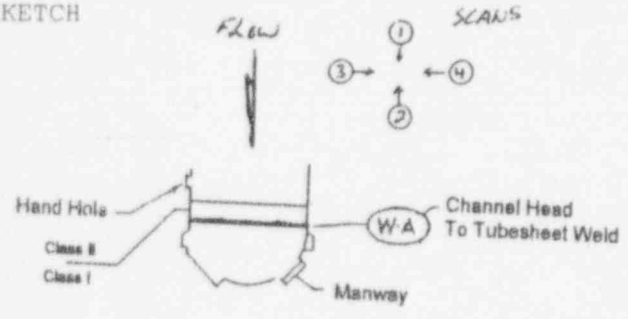
RESULTS NAD = No Apparent Discontinuities; L = Linear; S = Spot; M = Multiple
GEO = Geometry Visual = Non-Section XI Visual Examination

Scan Nmbr	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: Q. LOREDO II Level

Examiner: C.P. McELROY II Level

Contractor Review: 6/10/94 Date

NSP Review: 6/10/94 Date

ANII Review: 6/10/94 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°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 EFPY. The upper shelf for fracture toughness has been assumed to be 200 ksi$\sqrt{in}$. 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"

δ = 3.166"

δ/t = 0.566 (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.

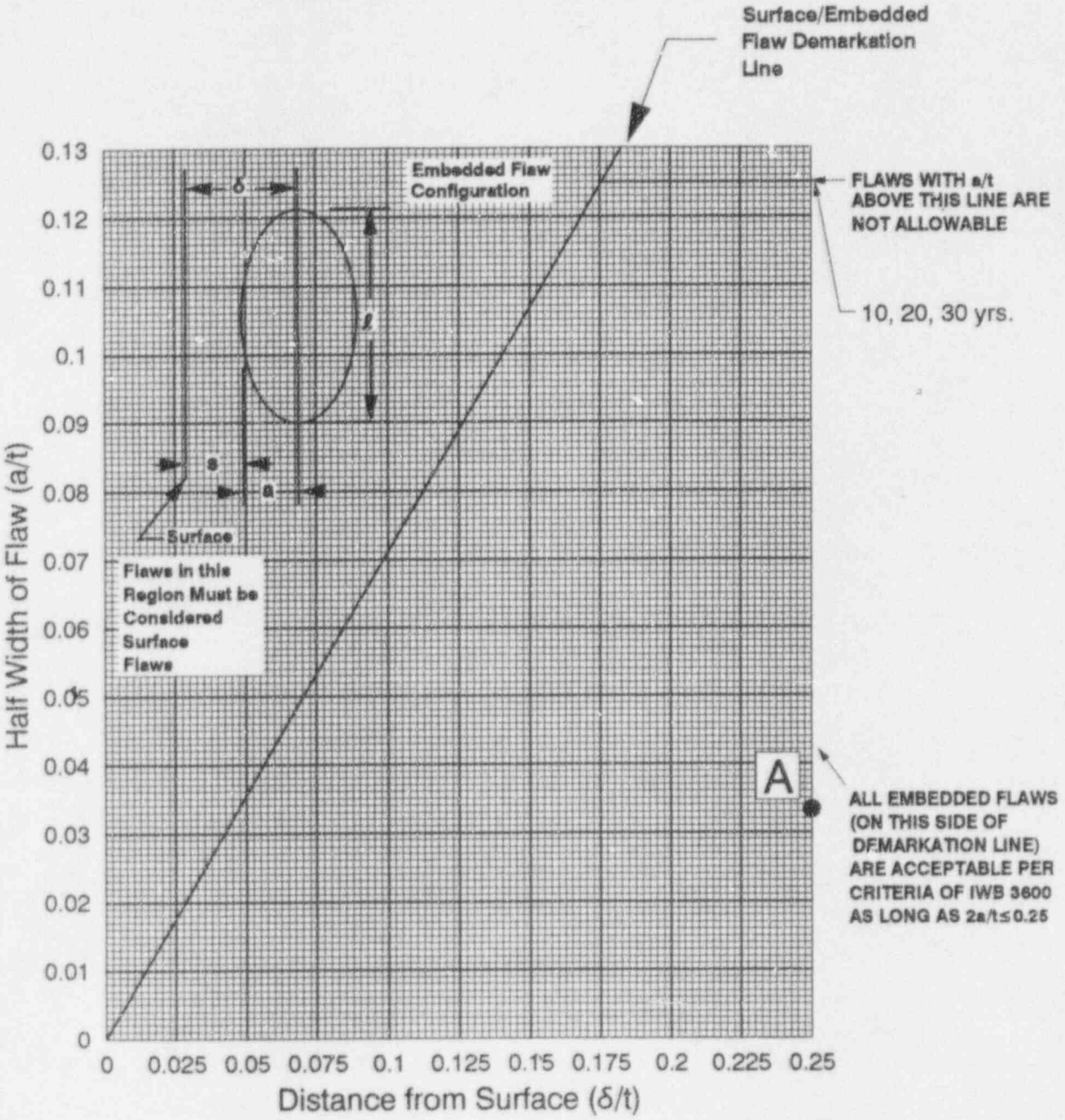


Figure 1. - Embedded Flaw Chart for the Tubesheet to Channel Head Weld Region Containing Indication Found in June 1994