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May 29, 1984

CONTAINS PROPRIETARY INFORMATION

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414

References:
1) Letter from W. H. Owen (Duke Power Company) to W. J. Dircks (NRC), dated September 19, 1983

2) Letter from H. R. Denton (NRC) to W. H. Owen (Duke Power Company), dated October 17, 1983

3) Letter from H. B. Tucker (Duke Power Company) to H. R. Denton (NRC), dated November 18, 1983

4) Letter from H. B. Tucker (Duke Power Company) to H. R. Denton (NRC), dated February 29, 1984

5) Letter from E. G. Adensam (NRC) to H. B. Tucker (Duke Power Company), dated May 8, 1984

6) Generic Letter 84-04, NRC, dated February 1, 1984.

Dear Mr. Denton:

Duke Power Company requested in Reference 4 NRC approval for application of the "leak-before-break" concept to the Catawba Nuclear Station to eliminate postulated pipe breaks in the Pressurizer surge line from the plant structural design basis. In Reference 5, the NRC requested additional information to complete the review of this leak-before-break analysis for Catawba Nuclear Staion, Unit 2. This letter is hereby submitted to provide this information and to request an exemption from General Design Criterion 4 (GDC-4). Additionally, a safety balance in terms of accident risk avoidance versus safety gains will be demonstrated.

Request for Additional Information

Westinghouse technical report WCAP-10487 (Enclosure A to Reference 4, proprietary) entitled "Technical Basis for Eliminating Pressurizer Surge Line Ruptures as the Structural Design Basis for Catawba Units 1 and 2" provides technical justification for elimination of Pressurizer surge line breaks for Catawba Nuclear Station (the non-proprietary version, WCAP-10488, was included as Enclosure B to Reference 4). Enclosure A to this letter provides the responses to the two items requested by the NRC in Reference 5.

B001 1/5 Change: BNL DMB/DSS FEMA LPDR PDR NSIC NTIS } Non Prop Only!

As Enclosure A contains information proprietary to Westinghouse Electric Corporation, it is supported by the attached letter (Attachment 1) and affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.790 of the Commission's regulations. Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.790 of the Commission's regulations. Correspondence with respect to the proprietary aspects of the Application for Withholding or the supporting Westinghouse affidavit should reference CAW-84-47, and should be addressed to R. A. Weisemann, Manager, Regulatory and Legislative Affairs, Westinghouse Electric Corporation, P. O. Box 355, Pittsburgh, Pennsylvania, 15230. Because of the proprietary nature of this report, Enclosure A has been provided only to the addressee and Mr. James P. O'Reilly of the NRC. A non-proprietary version is included as Enclosure B and has been provided to others on the attached distribution list.

Exemption Request

Pursuant to 10 CFR 50.12(a), Duke Power Company hereby applies in connection with the Catawba Nuclear Station license for an exemption from the provisions to 10 CFR Part 50, Appendix A, authorizing alternative pipe break analyses for the Catawba Nuclear Station Pressurizer surge line. The requested exemption is based upon the application of advanced fracture mechanics technology as evaluated in the Westinghouse technical report WCAP 10487 (Enclosure A of Reference 4).

Specifically, we request the elimination of postulated circumferential and longitudinal pipe breaks in the Pressurizer surge line from consideration in the structural design basis of Catawba Nuclear Station. The impact on important design aspects of implementing leak-before-break on Catawba Nuclear Station has been evaluated by Duke Power and is summarized in Attachment 2. A detailed list of previously postulated pipe breaks and associated rupture devices is provided in Attachment 3.

The bases for the requested exemption are as follow:

1. In-shop, pre-service, and in-service inspections performed on piping for the Catawba Nuclear Station minimize the possibility of flaws existing in such piping. The application of advanced fracture mechanics has demonstrated that if such flaws exist they will not grow to a leakage crack when subjected to the worst case loading condition over the life of the plant.

2. If one postulated a through-wall crack, large margins against unstable crack extension exist for certain stainless steel piping when subjected to the worst case loading conditions over the life of the plant.

The application of advanced fracture mechanics technology has demonstrated that small flaws or leakage cracks (postulated or real) will remain stable and will be detected either by in-service inspection or by leakage monitoring systems long before such flaws can grow to critical sizes which otherwise could lead to large break areas such as a double-ended rupture of the surge line. To date, use of this advanced fracture mechanics technology has been limited by the definition of a LOCA in Appendix A to 10 CFR Part 50 as including postulated double-ended ruptures of piping regardless of the associated probability. Application of the LOCA definition without regard to this advanced technology to large diameter thick-walled piping such as the Pressurizer surge line of a PWR imposes a severe penalty in terms of cost and occupational exposure because of the massive pipe whip restraints it requires which must be removed for in-service inspections. This penalty is unreasonable because these pipes do not have a history of failing or cracking and are conservatively designed. Accordingly, for design purposes associated with protection against dynamic effects, we request this exemption from the regulations to eliminate the need to postulate circumferential and longitudinal pipe breaks. This exemption request does not extend to specifying design bases for containment, the emergency core cooling system, or environmental effects.

We request that the exemption authorize, with respect to the plant structural design basis, the elimination of pipe breaks in the Pressurizer surge line. Thus, the use of advanced fracture mechanics permits a deterministic evaluation of the stability of postulated flaws/leakage cracks in piping as an alternative to the current mandate of overly conservative postulations of piping ruptures.

This exemption request is consistent with the provisions of footnote 1 to 10 CFR Part 50, Appendix A, which refers to the development of "further details relating to the type, size and orientation of postulated breaks in specific components of the reactor coolant pressure boundary." The Pressurizer surge line is a part of this boundary.

As support for this request, in addition to the previously specified information, we would request consideration of the following:

1. Letter from Darrell G. Eisenhut (NRC) to E. P. Rahe (Westinghouse) dated February 1, 1984.

2. Memorandum from Darrell G. Eisenhut (NRC) to All Operating PWR Licensees, Construction Permit Holders and Applicants for Construction Permits dated February 1, 1984 - Subject: Safety Evaluation of Westinghouse Topical Reports Dealing with Elimination of Postulated Pipe Breaks in PWR Primary Main Loops (Generic Letter 84-04).

3. CRGR resolution of generic issue A-2.

4. ACRS letter dated June 14, 1983, re: "Fracture Mechanics Approach to Pipe Failure."

5. Memorandum from William J. Dircks, EDO, to ACRS dated July 29, 1983, re: "Fracture Mechanics Approach to Postulated Pipe Failure."

6. Memorandum from Harold Denton (NRC) to Murray Edelman (AIF), dated May 2, 1983.

Safety Balance

Further, pursuant to 10 CFR 50.12(a), we believe the requested exemption will not endanger life or property or the common defense and security and is in the public interest. The total increase in public and occupational accident exposure associated with omitting the Pressurizer surge line whip restraints and jet deflectors is estimated to be less than .5 man-rem for the nominal case with 40-year plant life. This estimate is based on an analysis similar to that for the primary loop in the "Leak-before-Break Value-Impact Analysis" of Enclosure 2 to Reference 6, but performed specifically for the Pressurizer surge line. The major difference in the analysis is that a surge line break will not contribute to asymmetric blowdown; therefore, no LOCA is assumed to occur in the reactor cavity for the surge line break. A reactor cavity LOCA leads to a majority of the potential accident risk for the primary loop; thus, a surge line break would result in a lower risk than a primary loop break.

The benefits in avoidance of exposures for Catawba Unit 2 associated with the requested exemption are estimated to be 216 man-rem of occupational exposure over plant life, based on Duke Power studies. This eliminated radiation exposure is related to pipe whip restraint inspection tasks, restraint disassembly/reassembly for pipe weld inspections, and improved personnel access for operation and maintenance. Consequently, the savings in exposure by granting the exemption far exceed the potentially small increase in public risk and occupational accident exposure associated with deleting restraint devices. Duke Power Company estimates cost savings for Catawba Nuclear Station, Unit 2 of at least 1.7 million dollars as given in Attachment 4. Benefits with regard to plant safety, operation, and design are given in Attachment 4.

With these benefits and with a net reduction of radiation exposure of 216 man-rem, a net safety gain has been demonstrated for Catawba Unit 2. Also, a cost savings of at least 1.7 million dollars has been shown, and a technical basis for elimination of Pressurizer surge line breaks has been demonstrated. Implementation of the leak-before-break concept will thus be cost-effective as well as technically justifiable while resulting in improved overall plant safety. Therefore, Duke Power Company hereby requests NRC approval of an exemption to GDC-4 in order to apply the leak-before-break concept to Catawba Nuclear Station to eliminate postulated pipe breaks in the Pressurizer surge line from the plant structural design basis.

Enclosure C of Reference 4 consists of the revised Catawba FSAR pages associated with the elimination of pressurizer surge line breaks, and it will be included in a future revision to the FSAR. This current request is for implementation on Unit 2 only; Duke Power will submit additional information prior to implementation on Unit 1.

Construction completion of the Pressurizer surge line devices at Catawba Unit 2 is on hold pending an NRC ruling on this proposal. We request a resolution concerning this matter prior to June 25, 1984.

If I can be of further assistance, or if a meeting with the staff is deemed beneficial for a final resolution of this matter, please contact me.

Very truly yours,

Hal B. Tucker

ROS/KWH/php

Attachments

cc: (w/proprietary attachments)
Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

(w/o proprietary attachments)
NRC Resident Inspector
Catawba Nuclear Station

Mr. Robert Guild, Esq.
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P. O. Box 12097
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Carolina Environmental Study Group
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Charlotte, North Carolina 28207

Attachment 2

Impact of Elimination of Postulated Circumferential and Longitudinal Pipe Breaks in the Pressurizer Surge Lines

Structures, Systems, Components, Programs Considered for Impact	Impact
Pressurizer Surge Line Pipe Whip Restraints and Jet Barriers	Deleted from Design
Primary Shield Wall/Crane Wall/ Operating Floor	Reduction in pressurization loading
RCS Pressure Boundary Leakage Detection Systems	No change
Environmental Qualification Program	No change

Attachment 3

Postulated Pressurizer Surge Line Pipe Breaks
and Associated Rupture Devices

Postulated Break Location	Devices Associated with Break*	Erection Status Catawba Unit 2
1. Terminal end at Pressurizer Nozzle	21 pipe whip restraints	Not installed
2. Terminal end at hot leg connection	21 pipe whip restraints and 2 jet deflectors	Not installed
3. Intermediate break at Node 2AA	21 pipe whip restraints	Not installed
4. Intermediate break at Nodes 9B, 9ABA, & 9AB	21 pipe whip restraints and 1 jet deflector	Not installed

* All 21 Pressurizer Surge Line pipe whip restraints are loaded by each of this line's breaks. Thus, the total number of devices being deleted is 21 pipe whip restraints and 3 jet deflectors.

Attachment 4

Summary of Benefits from the Elimination of Pressurizer Surge Line Pipe Breaks on Catawba Nuclear Station Unit 2

Category	Benefit
1. Design, material and erection costs associated with 24 rupture devices.	$1.1 million*
2. Plant design	Simplifies overall plant design by elimination of potential interferences with piping, hangers, impulse tubing, etc.
3. Relief of congestion, improving access for operation and maintenance.	216 man-rem reduction in radiation exposure over life of Unit 2 ($595,000)
4. Reduction in piping heat loss at whip restraint locations.	Not quantitatively assessed. Insulation can be installed on piping at current locations of Pressurizer Surge Line pipe whip restraints.
5. Improvement in overall plant safety (NUREG/CR-2136).	Improvement in ISI quality. Elimination of potential for restricted thermal or seismic movement.

* Current (1984) dollars.

ENCLOSURE B
ADDITIONAL INFORMATION

CATAWBA SURGE LINE

Question 1

Paragraph 5.2 on page 5-2 of Reference (a)*below states that the pipe is subjected to internal pressure and an axial load (underlining added). Similar statements appear elsewhere in the report, however, other information presented indicates that the axial force due to pressure is included in the axial load. Please clarify.

Response:

The surge line under investigation is subjected to a pressure of [ ] a,c,e
The pressure causes an axial load of [ ]. In addition, the pipe a,c,e
is subjected to other axial forces of [
] Thus, the pipe is subjected a,c,e
to a total axial load of [ ] kips. a,c,e

Since the [ ] an axial force does not result a,c,e
by applying the pressure of [ ] surfaces. Therefore, to a,c,e
simulate the actual pipe loading an axial force of [
] has to be applied to the a,c,e
[ ] in the axial direction in addition to the pressure of [ ] applied a,c,e
to [ ] a,c,e

Question 2

The Paragraph at the top of page 3-2 of Reference (a)* below identifies the weld connection between the [
] as being a,c,e
the limiting location to be analyzed. Figure 7-2, page 7-12, is a schematic drawing of this location. Provide the materials properties for the weldment as well as for the base metal, preferably in the form of a J-resistance plot. State the maximum value of J-material to be considered in your analyses and your basis for it.

Response:

The fracture toughness J_{Ic} used for the 304 forged pipe was obtained from the compilation of test results for this material reported in Reference 1. The table of toughness results presented in this reference is reproduced in the attachment. It is easily seen that the value of [ ] used in a,c,e
the report is the minimum of the three sets of test results reported. The J integral R curves for each of the three sets of tests at 600F are also provided in the attachment, and are the original figures from Reference 1.

The fracture toughness of stainless steel welds has been found to range from about [ ] to over [ ] in recent studies. The weld J_{Ic} a,c,e
value of [ ] is representative of the lower toughness values avail- a,c,e
able for stainless steel welds used in commercial fabrication, and was obtained directly from Reference 2 and also published in Reference 3.

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*Reference: a. WCAP-10487, 2/10/84

The highest value of applied J used in the analyses of WCAP 10487 is [ ] in-lb/in^2, as demonstrated in the report. The maximum applied J in the weld metal will be lower, because of the higher yield strength of the weld metal. a,c,e

The maximum value of J obtained in the fracture tests is in excess of 25000 as may be seen from examining the plots attached for base metal tests. The maximum value of J obtained in the weld metal tests was in excess of [ ] in-lb/in^2. a,c,e

REFERENCES

1. Bamford, W. H. and Bush, A. J., "Fracture Behavior of Stainless Steel" in Elastic Plastic Fracture, ASTM STP 668, American Society of Testing and Materials 1979, pp. 553-557.

2. Slama, G., et.al., Effect of Aging on Mechanical Properties of Austenitic Stainless Steel Casting and Welds, presented at SMiRT Post Conference Seminar 6 - Assuring Structural Integrity of Steel Reactor Pressure Boundary Components, August 1983, Monterey, Calif.

3. Bamford, W. H., et.al., "The Effects of Thermal Aging on the Structural Integrity of Cast Stainless Steel Piping for Westinghouse Nuclear Steam Supply Systems, Westinghouse Electric Corp. WCAP 10456, Nov. 1983. (W Proprietary Class 2).

TABLE 3

J_{IC} FRACTURE TOUGHNESS RESULTS

MATERIAL	ORIENTATION	SPECIMEN	TEMPERATURE	J_{IC}* (IN LB/IN^2)
304 FORGED STAINLESS (CI SPECIMENS)	AXIAL / CIRCUMFERENTIAL	2T-CT	RT	4449
	CIRCUMFERENTIAL	3 PT BEND	RT	>4000
	AXIAL / CIRCUMFERENTIAL	2T-CT	316°C	2569
	CIRCUMFERENTIAL	3 PT BEND	316°C	2737
	RADIAL	1T-CT	316°C	2308
316 CAST STAINLESS (SW SPECIMENS)	AXIAL / CIRCUMFERENTIAL	2T-CT	RT	4293
	CIRCUMFERENTIAL	3 PT BEND	RT	>4000
	CIRCUMFERENTIAL	CENTER CRACKED PANEL	RT	4568
	AXIAL / CIRCUMFERENTIAL	2T-CT	316°C	1933
	CIRCUMFERENTIAL	3 PT BEND	316°C	2908
304 PLATE (J SPECIMENS)		1T-CT	316°C	1500

Note: All results here were obtained from multiple specimen tests

*To convert from in lb/in^2 to MJ/m^2 multiply by 0.0001751

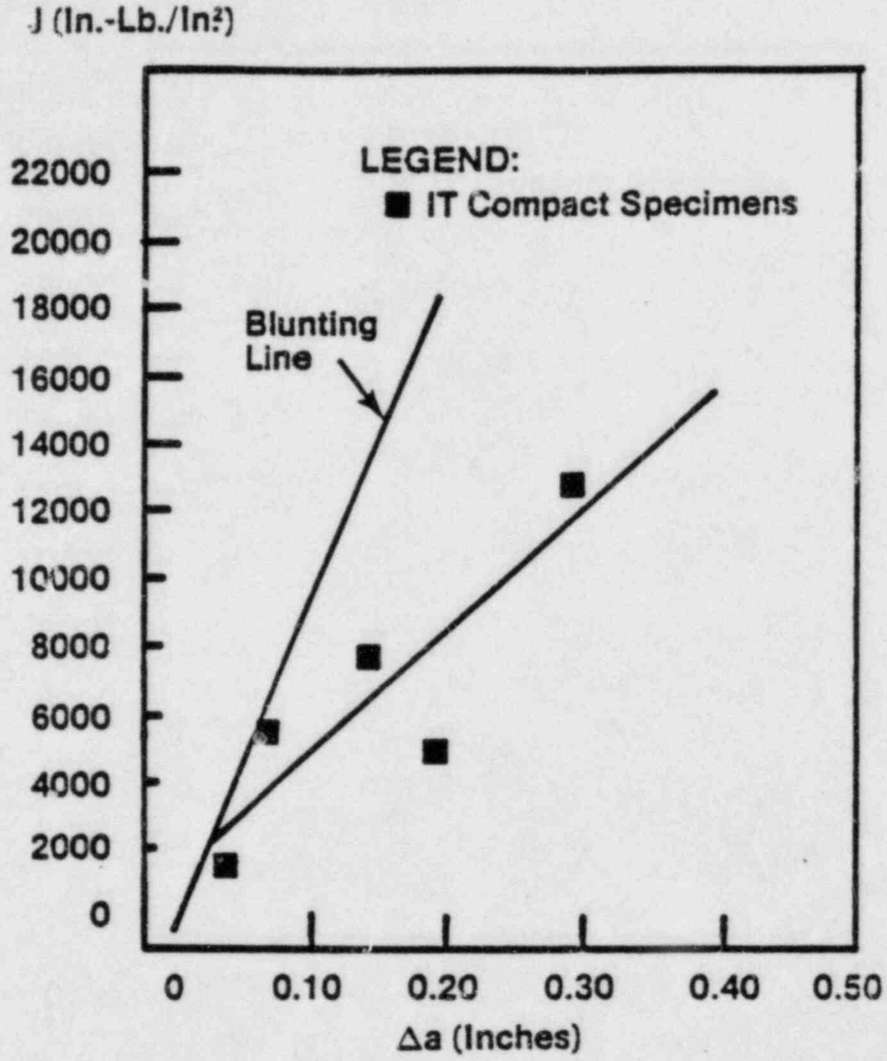

Figure 11. J_{IC} Determination - 304 Forged Stainless Steel - Radial Orientation - Compact Specimens

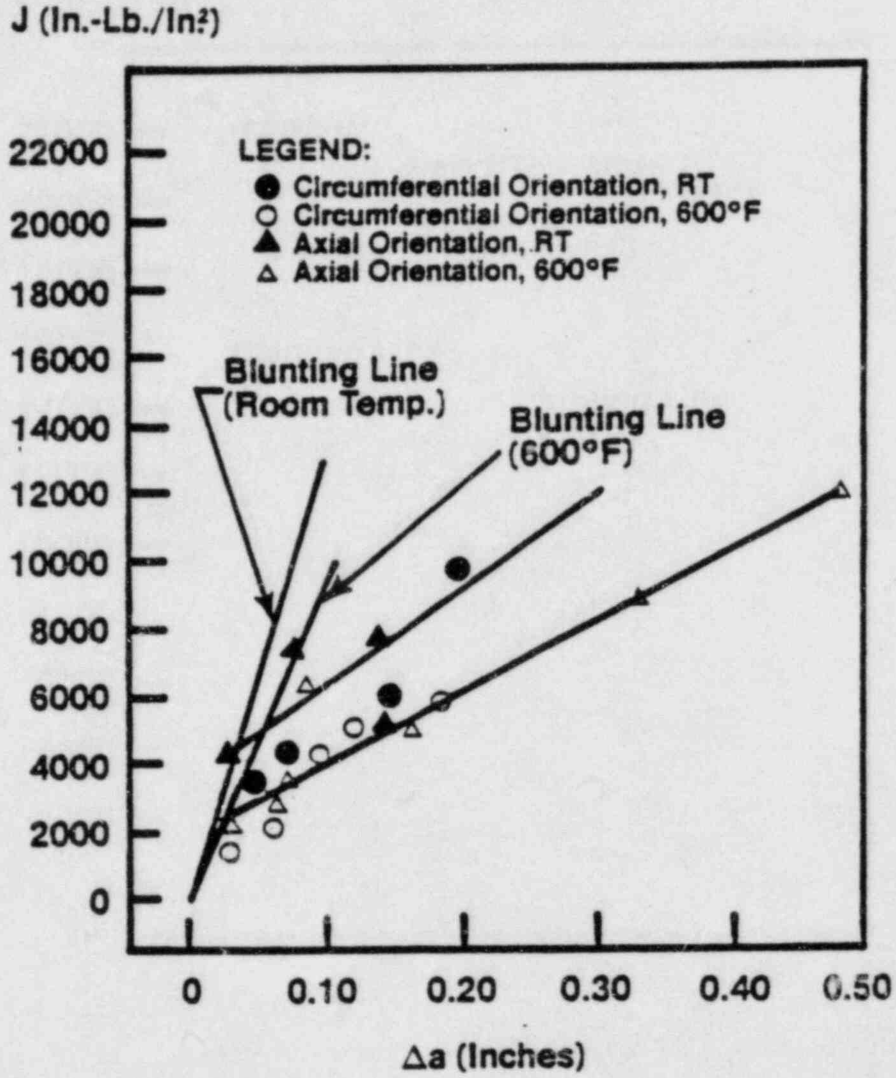

Figure 10. J_{IC} Determination - 304 Forged Stainless Steel - Compact Specimens

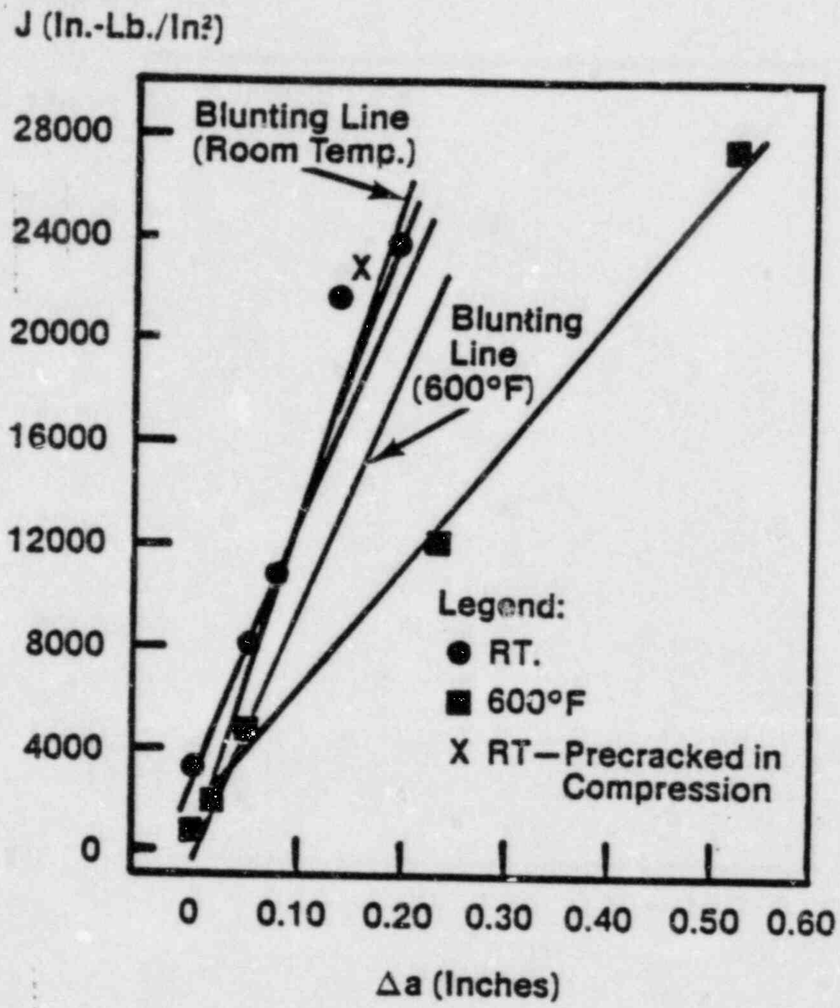

Figure 14. J_{IC} Determination - 304 Forged Stainless Steel - Three Point Bend Specimens

[ ] +a,c,e

Figure 2.4-8: [ ] a,c,e