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SHIELDS L. DALTROFF
VICE PRESIDENT
ELECTRIC PRODUCTION

November 15, 1985

Docket No. 50-278

Mr. John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Peach Bottom Atomic Power Station, Unit 3
Recirculation System Welds 2-AS-8 and 2-BD-12

REFERENCE: (1) Letter, S. L. Daltroff, PECo, to
J. F. Stolz, USNRC, dated December 15, 1984

Dear Mr. Stolz:

This letter transmits the results of an evaluation prepared for Peach Bottom Unit 3 Recirculation System Welds 2-AS-8 (pipe-to-suction valve weld on the 'A' recirculation line) and 2-BD-12 (pipe-to-discharge valve weld on the 'B' recirculation line). The attached evaluation, which was prepared by General Electric Company, demonstrates that the crack indications discovered in these welds satisfy the acceptance criteria of Generic Letter 84-11 and ASME Code Section XI, although the indications do exceed 30% circumference and fall into the category where "repair is likely to be required", as stated in item 3 of Attachment 2 of Generic Letter 84-11. All other butt welds in this category have been overlay repaired. The evaluation also concludes that continued operation for a minimum of 18 months without weld repairs is justified.

Performance of weld overlay repairs has been considered for the subject welds. These pipe welds are located in the drywell and it has been determined that considerable interference exists in the areas of both welds. Several small pipes, hanger lugs, drain lines, pieces of grating, and a decontamination flange would have to be cut out and later reinstalled to provide space for the welding equipment. Removal and reinstallation of these items would add significantly to the radiation exposure and the time required to perform the overlay repairs and would also result in outage



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extension. This information is summarized in the following table:

| | 2-AS-8 | 2-BD-12 | Typical 28" Weld |
|---|---|---|---|
| Exposure (Man-Rem) | 70 | 82 | 20 |
| Repair Time (Days) | 19 | 24 | 14 |

In accordance with item 2(a) of Attachment 2 of Generic Letter 84-11, prior NRC approval of the attached analysis is required to return Unit 3 to power operation. The current Unit 3 refueling outage is scheduled for completion in December, 1985; therefore, prompt attention to this matter would be appreciated.

If we can provide any additional information, please do not hesitate to contact us.

Very truly yours,

Attachment

cc: Dr. T. E. Murley, Administrator, Region I, USNRC
T. P. Johnson, Resident Site Inspector

GENERAL ELECTRIC

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GENERAL ELECTRIC COMPANY • 1000 FIRST AVENUE • KING OF PRUSSIA, PENNSYLVANIA 19406

G-HE-5-572
November 13, 1985

K. J. Wilson
PHILADELPHIA ELECTRIC COMPANY
2610 South Delaware Avenue
Philadelphia, PA 19142

SUBJECT: Peach Bottom 3 IGSCC Contingency Program
Flaw Evaluation - Welds 2-AS-8 and 2-BD-12

This letter summarizes the results of the flaw evaluations performed for the Peach Bottom Unit 3 Recirculation Line Welds 2-AS-8 and 2-BD-12. The evaluation demonstrates compliance with the requirements of Generic Letter 84-11, as well as the newly developed acceptance criteria for flux weldments which has been proposed for ASME Code Section XI in Table IWB-3641-5 and is currently on review. The results show that the flaws are acceptable for at least 18 months of operation.

## Method

Crack growth analyses were performed to determine the depth of the cracks after 18 months of operation. This analysis involved the calculation of a stress intensity factor and crack growth rate. The stress intensity factors were calculated using the polynomial fit method developed by Buchalet and Bamford (Reference 1). Crack growth was determined using the upper bound weld sensitized crack growth data shown in Figure 1 (Reference 2).

## Assumptions

A summary of the composite crack indication sizing performed independently by GE and Southwest Research Institute (SWRI) is shown in Table 1. The crack lengths were conservatively assumed to be equal to the sum of the individual lengths and the depth equal to the average depth. The evaluations were performed using the average flaw depth, since the measured depths were highly localized peaks (or cusps) at separate locations. We believe that these averages represent a reasonable flaw assumption for these welds.

Stresses

The applied stresses are typical of the stresses in other welds in this line. These stresses consist of the original design stresses (pressure, thermal expansion, dead weight) and shrinkage stress, as shown in Table 2. This stress is due to axial shrinkage of the weld overlays in the loop. For this analysis, upper bound shrinkage stresses are used based on piping system finite element modeling results.

In addition, one of the following two residual stress distribution assumptions were applied:

2-BD-12

Large diameter pipe weld residual stress, as shown in Figure 2, applies to this joint since it has not been treated with Induction Heating Stress Improvement (IHSI).

2-AS-8

This weld was IHSI treated in 1983. The plasticity that occurs during this treatment will tend to neutralize existing as-welded stress distributions. Therefore, this analysis conservatively assumes no residual stress, but does not take credit for the beneficial IHSI residual stresses.

Using these stresses, a crack growth evaluation was performed for each indication and compared to the following criteria.

Criteria

The first criterion is that the crack should not exceed the limit for net section collapse using a safety factor of 3.0.

The second criterion is that the crack should not exceed 2/3 of the limits for depth and length provided in the ASME Code Section XI, Paragraph IWB-3640.

The last criterion is that the crack should not exceed the limit on allowable flaw size for flux weldments. This criterion is proposed for ASME Code Section XI in Table IWB-3641-5. (This criterion is currently on review within the Section XI Committee.)

Results

The predicted crack growth and the allowable flaw size for both welds are shown in Figures 3 and 4. Considering the average depth, it is seen that there is a significant margin for both welds. In fact, even with a conservative assumption of peak depth, operation without repair can be justified for 18 months. Thus, based on the evaluations, operation as-is is acceptable for each of these joints.

As defined in the three criteria, the analyses demonstrate compliance with the requirements of the NRC Generic Letter 84-11, as well as the newly developed acceptable criteria for flux weldments.

Sincerely,

R. L. Lebre
Program Manager

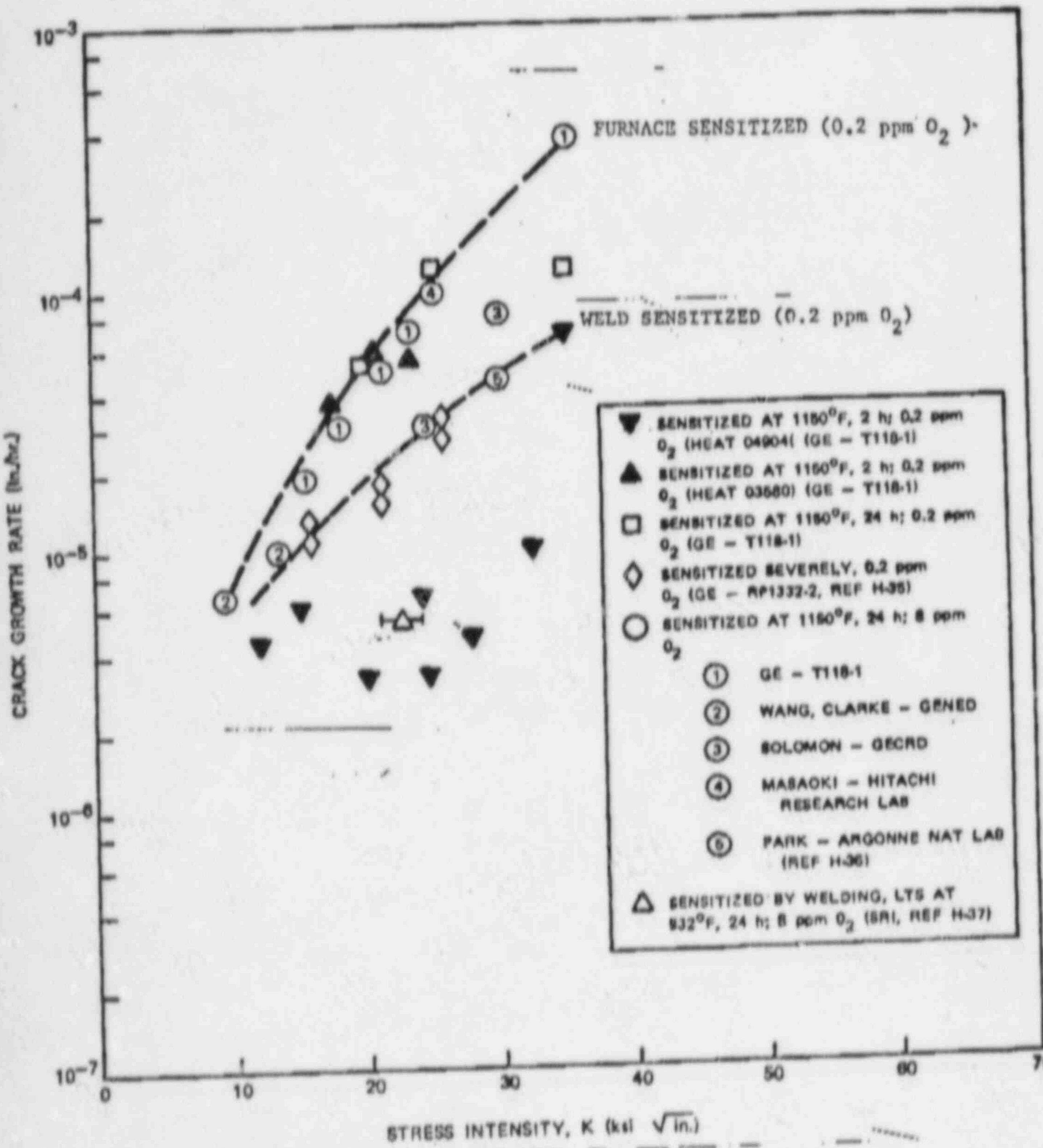


Figure 1. Crack Growth Data and Disposition Curve Analysis

# TABLE 1 CRACK INDICATION SIZING

| WELD | TYPE | LOCATION | AZIMUTH | DEPTH | REMARKS |
|---|---|---|---|---|---|
| 2-AS-8 | SS Elbow<br>Cast SS Valve<br>(IHSI Treated) | Elbow | 0-4" | 20% | |
| | | | 18-40" | 20% | Local Cusp of 40% assumed length = 1 inch |
| | | | 54-58" | 20% | Local Cusp of 35% assumed length = 1 inch |
| | | | 74-78" | 20% | |
| | | | 88-90" | 20% | |
| | | | | AVG. 21% | |
| 2-ED-12 | SS Pipe<br>Cast SS Valve<br>(not IHSI Treated) | Pipe | 3-11" | 20% | Local Cusp of 30% assumed length = 1 inch |
| | | | 16-17" | 25-30% | |
| | | | 22-25" | 20% | |
| | | | 35-41" | 5% | |
| | | | 46-60" | 20-25% | |
| | | | 63-68" | 20% | Local Cusp of 30% assumed length = 1 inch |
| | | | 74-81" | 20% | |
| | | | | AVG. 21% | |

TABLE 2 RECIRCULATION PIPING WELD STRESSES

| WELD IDENT. | PIPE SIZE (in.) | WALL THICKNESS (in.) | PRESSURE STRESS (ksi) | THERMAL EXPANS. (ksi) | DEAD-WEIGHT (ksi) | SEISMIC (OBE) (ksi) | SHRINKAGE STRESS (ksi) |
|---|---|---|---|---|---|---|---|
| 2-AS-08 | 28 | 1.138 | 6.46 | 1.00 | 0.43 | 1.28 | 2.0 |
| 2-BD-12 | 28 | 1.138 | 8.00 | 0.71 | 0.27 | 0.77 | 1.0 |

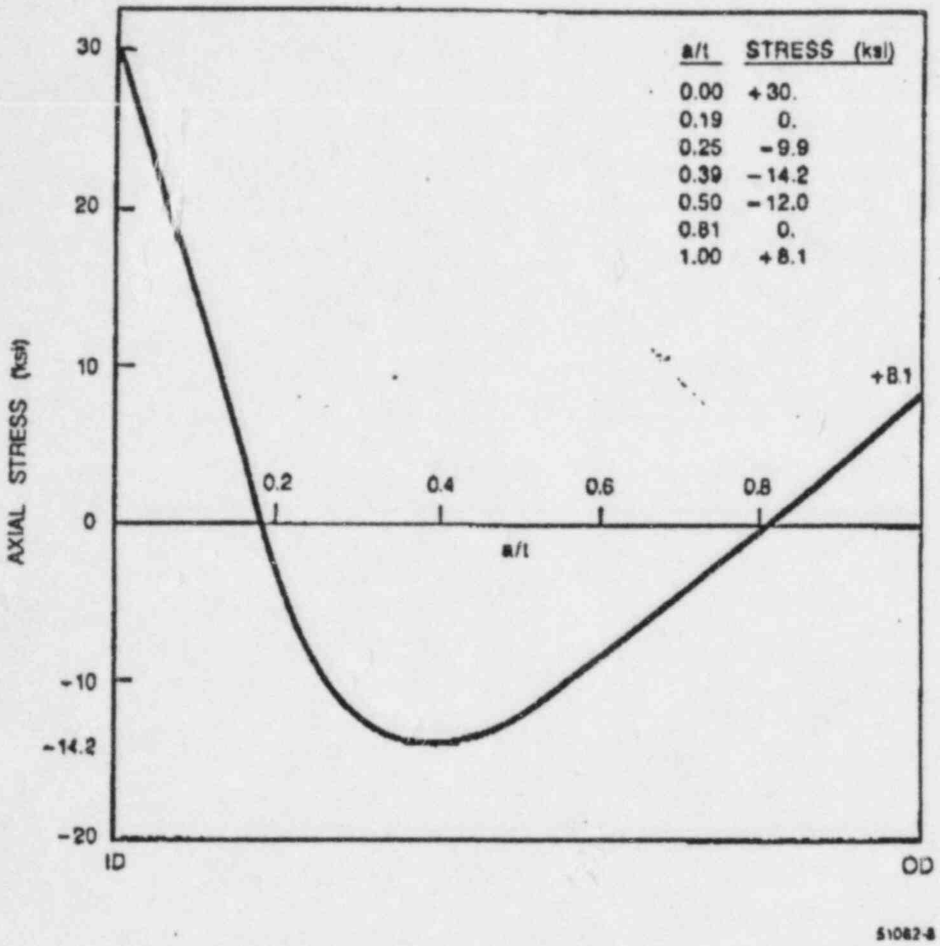


*Figure 2. Large Diameter Pipe Axial Weld Residual Stress Distribution (22 in. to 28 in.)*

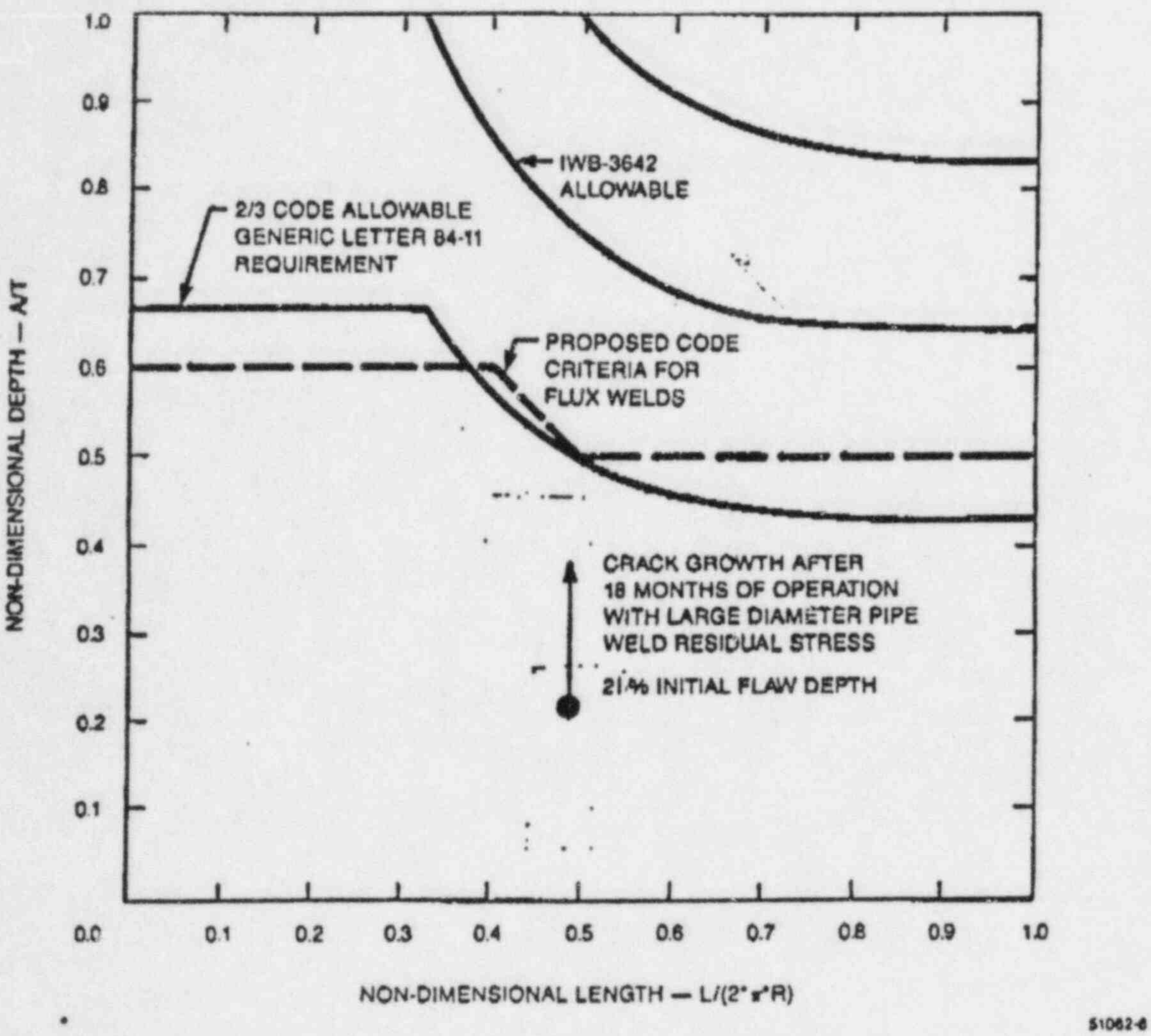


*Figure* 3. *Flaw Acceptance Diagram for Weld 2-BD-12 Large Diameter Pipe Weld Residual Stress Assuming Average Flaw Depth*

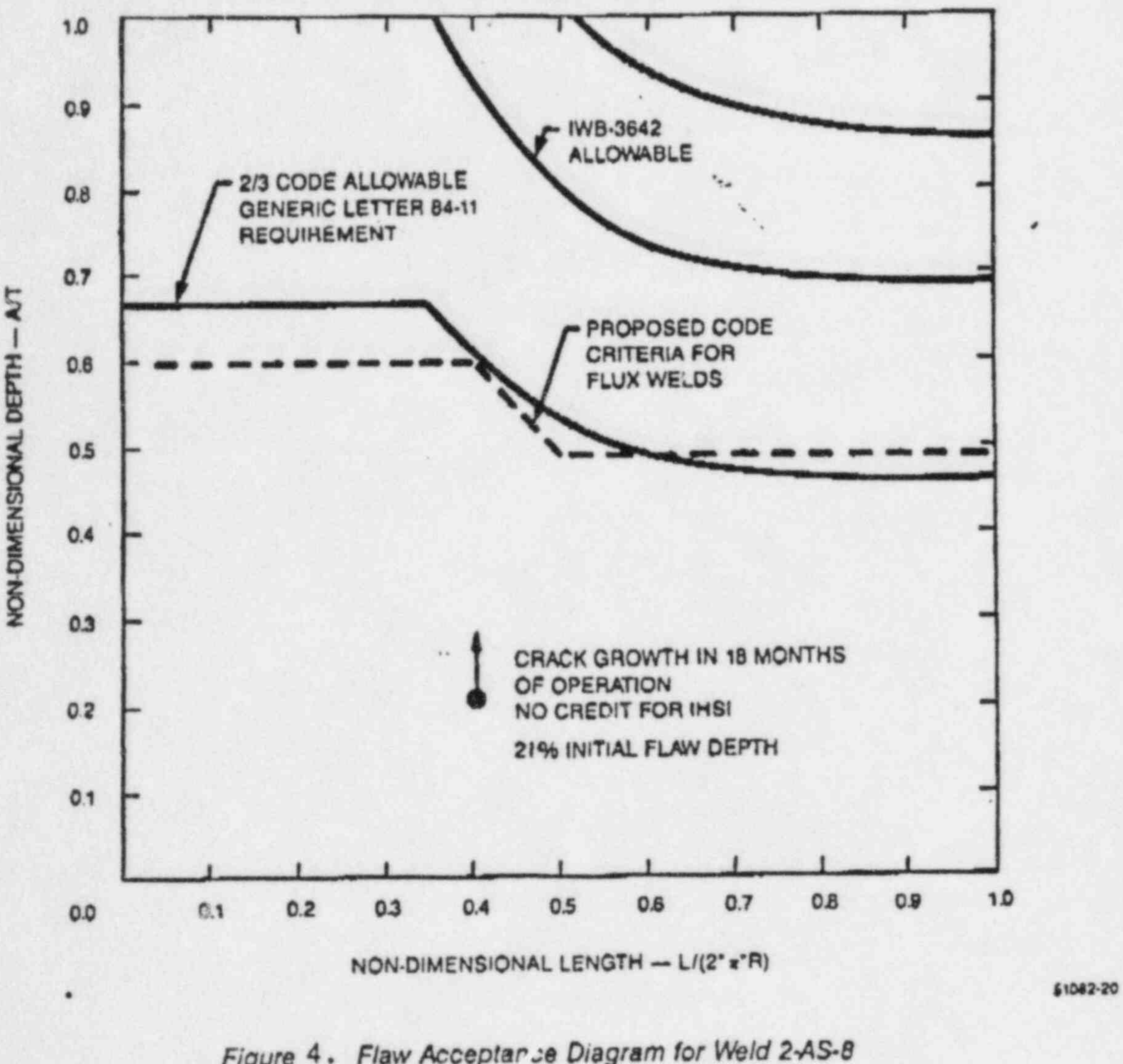


*Figure 4. Flaw Acceptance Diagram for Weld 2-AS-8*
*No Credit for IHSI Assuming Average Flaw Depth*

## REFERENCES

1. C. B. Buchalet and W. H. Bamford, "Stress Intensity Factor Solution for Continuous Surface Flaws in Reactor Pressure Vessels," Mechanics of Crack Growth, ASTM STP 590, 1979.

2. R. M. Horn and S. Ranganath, "Determination of Crack Growth Rates in Sensitized Austenitic Piping," Proccedings: Second Seminar on Countermeasures for Pipe Cracking in BWRs, Volume 1: Problem Resolution, EPRI, Palo Alto, CA. (EPRI NP-3684-SR), September, 1984, pp. 10-111 through 10-12.