ATTACHMENT B

PHILADELPHIA ELECTRIC COMPANY

PEACH BOTTOM ATOMIC POWER STATION

UNIT 3

DOCKET NO. 50-278

GENERAL ELECTRIC COMPANY'S FRACTURE MECHANICS EVALUATION AND OVERLAY WELD REPAIR DESIGN

DRF #137-0010
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SR03.DA

EVALUATION OF THE INDICATIONS IN THE PEACH BOTTOM 3 JET PUMP INSTRUMENTATION NOZZLE SAFE END-REDUCER WELD

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Mechanics Analysis

1. EVALUATION BASIS

Evaluation was performed for two sets of assumed flaw configurations as measured flaw sizes.

(I) A Loop weld: Composite flaw 1.87 inches long 0.075 inch deep
B Loop weld: 0.75 inch long, 0.175 inch deep circumferential flaw

These flaw sizes were based on best estimates of Level II inspector.

(II) In the second evaluation, a through-wall flaw equal to 1/6 of the circumference (16.7%) was postulated. This conservative assumption was made since the UT inspection was somewhat restricted over approximately 1/3 of the circumference. The Level III inspector felt that in this position, the UT results were effective over half the length (or 1/6 of the circumference). The assumption of a 16.7% through-wall flaw therefore represents a limiting condition.

The following stress values were used for the purpose of predicting crack growth and allowable flaw sizes.

P_m = 3 ksi (pressure stress - pd/4t)
$P_m + P_b$ = 5 ksi

The $P_m + P_b$ was an estimate since the information was not available in the stress report. Nevertheless, it is reasonable since the reducer is not connected to any piping and therefore experiences no piping loads. Seismic loads are also insignificant.

For crack growth analysis a residual (bending) stress of 30 ksi is assumed. Crack growth rates corresponding to furnace sensitized material in 8 ppm oxygenated water (Figure 1) was used. This is appropriate since the environment in the reducer is stagnant.

2. EVALUATION OF CRACKS PER UT SIZING

Figures 2 and 3 show the allowable flaw sizes per IWB-3642 (safety factor of 3) on the same plot, the as-measured initial flaw size, and predicted crack is shown. Based on the assumed conservative furnace sensitized crack growth rate, both cracks are predicted to grow to through-wall in approximately 3000 hours. Although a through-wall crack is predicted, it is still within the allowable value since the safety factor of 3 can be maintained with a through-wall crack of over 40% of the circumference. Even after the crack becomes through-wall, further circumferential crack growth can be tolerated before the Code allowable length is exceeded. Thus, the component is acceptable for continued operation for at least 3000 hours.

3. EVALUATION ASSUMING THROUGH-WALL FLAW

In this limiting calculation a through-wall crack of 16.7% circumference is assumed. Figure 4 shows that this is within the allowable crack length per IWB-3642 of Section XI ASME Code. Assuming an average circumferential crack growth rate of 2×10^{-4} in/hr (corresponding to the plateau growth rates for furnace-sensitized material), it would take 9000 hours before the Code limits are reached. Thus, the flaw is acceptable even with the limiting assumptions.

4. LEAK-BEFORE-BREAK CONSIDERATIONS

Experience has shown that cracks in small diameter piping lead to leaks which are detected by leak detection systems. The circumferential variations in weld residual stress produce preferential crack growth which leads eventually to local leak. In fact, if one assumes a through-wall crack equal to 1/6 of the circumference, the expected leakage rate is of the order on 0.5 gpm. This could be detected by special leak monitors such as moisture sensitive tape. In any case, leak-before-break remains valid and provides inherent safety margins.

5. CONCLUSION

Continued operation can be justified for at least 3000 hours of operation, even with conservative assumptions on initial crack size and crack growth rate. Even if the indication becomes a through-wall flaw, Code safety margins would be preserved for a much longer period. Leak-before-break provides additional safety margin.

NEDE-30538
GENERAL ELECTRIC COMPANY
PROPRIETARY INFORMATION
CLASS III

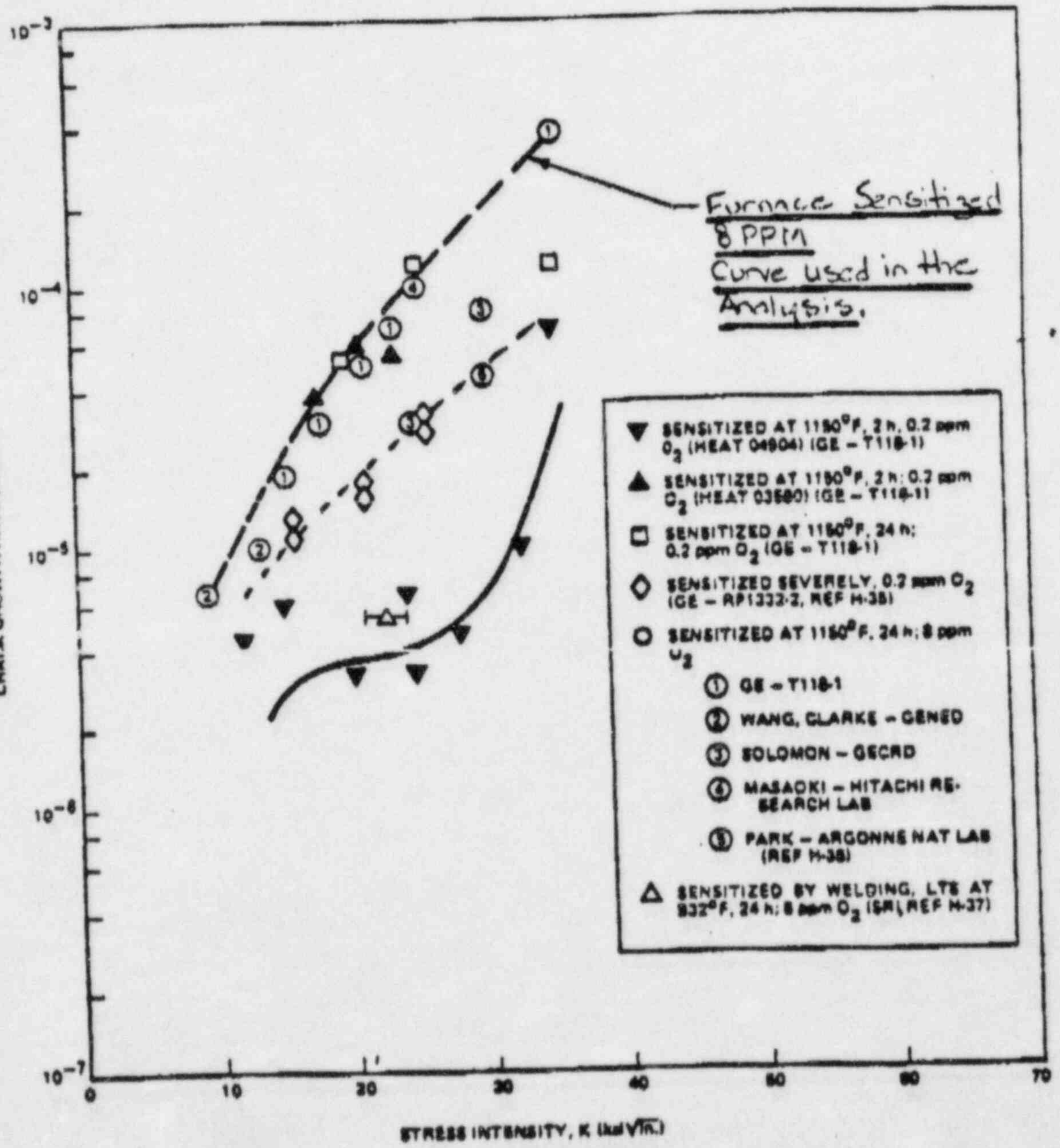


Figure . 1 Summary of 304SS Constant Load Crack Growth Data

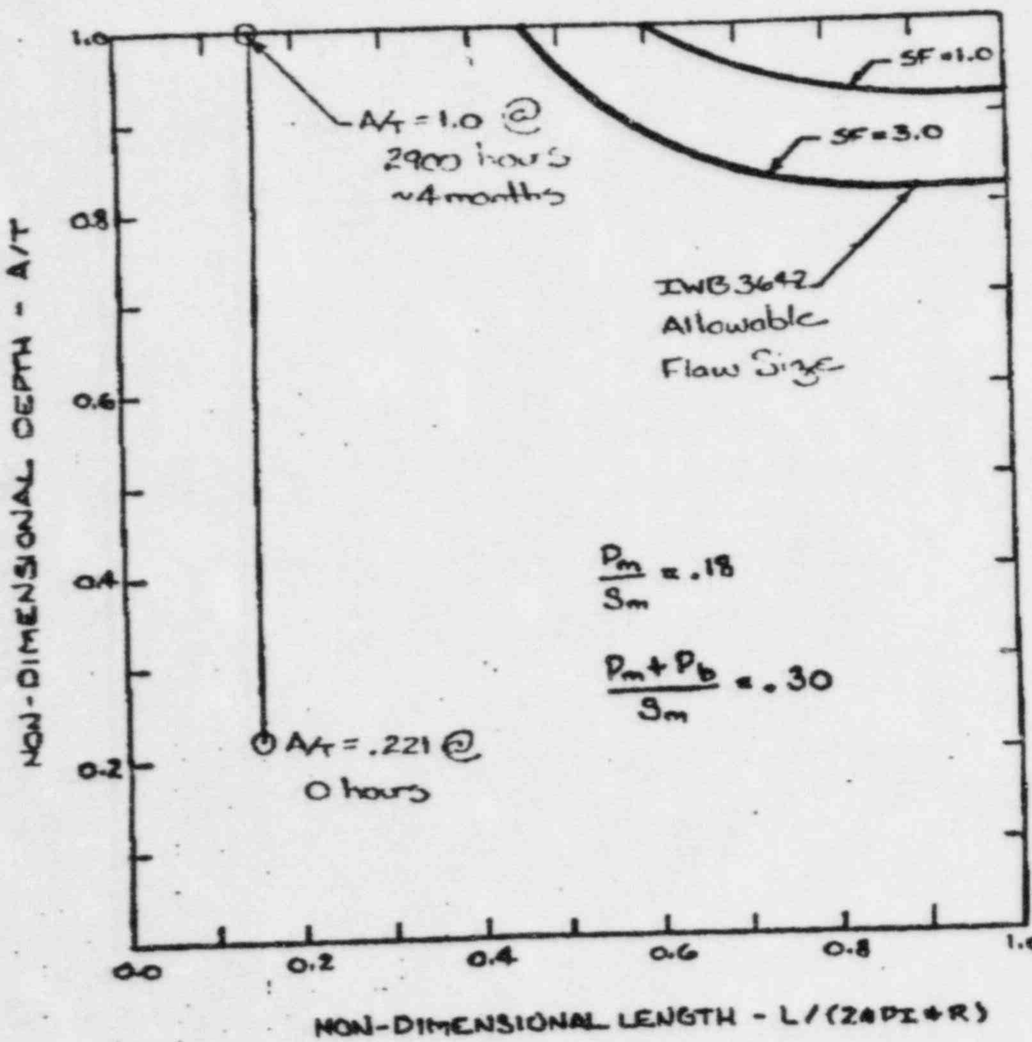
Fig 2.

Peachbottom II

Loop A Flaw Failure Diagram

Buchalet Bamford

FURNACE SENSITIZED



Loop B Flaw
Circumferential
length = 1.87"
through wall = .075"
measured thickness =
.340

a/ℓ = .04
a/t = 22%

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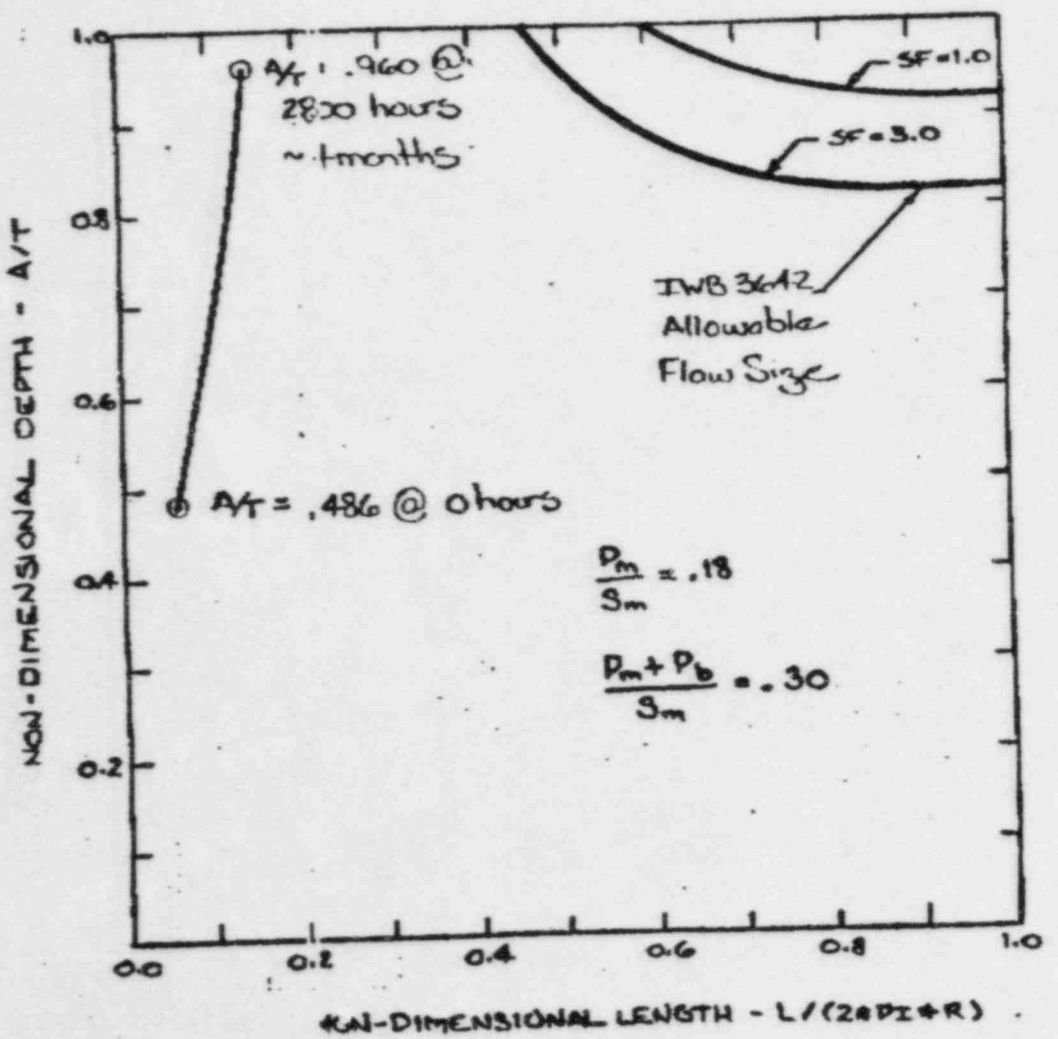
Fig

Peachbottom II

Loop B Flaw Failure Diagram

SECTION 11

FURNACE SENSITIZED



Loop A Flaw
Circumferential
length = .75"
through wall = .175"
measured thickness = .360"

a/l = .23
a/t = 48.6%

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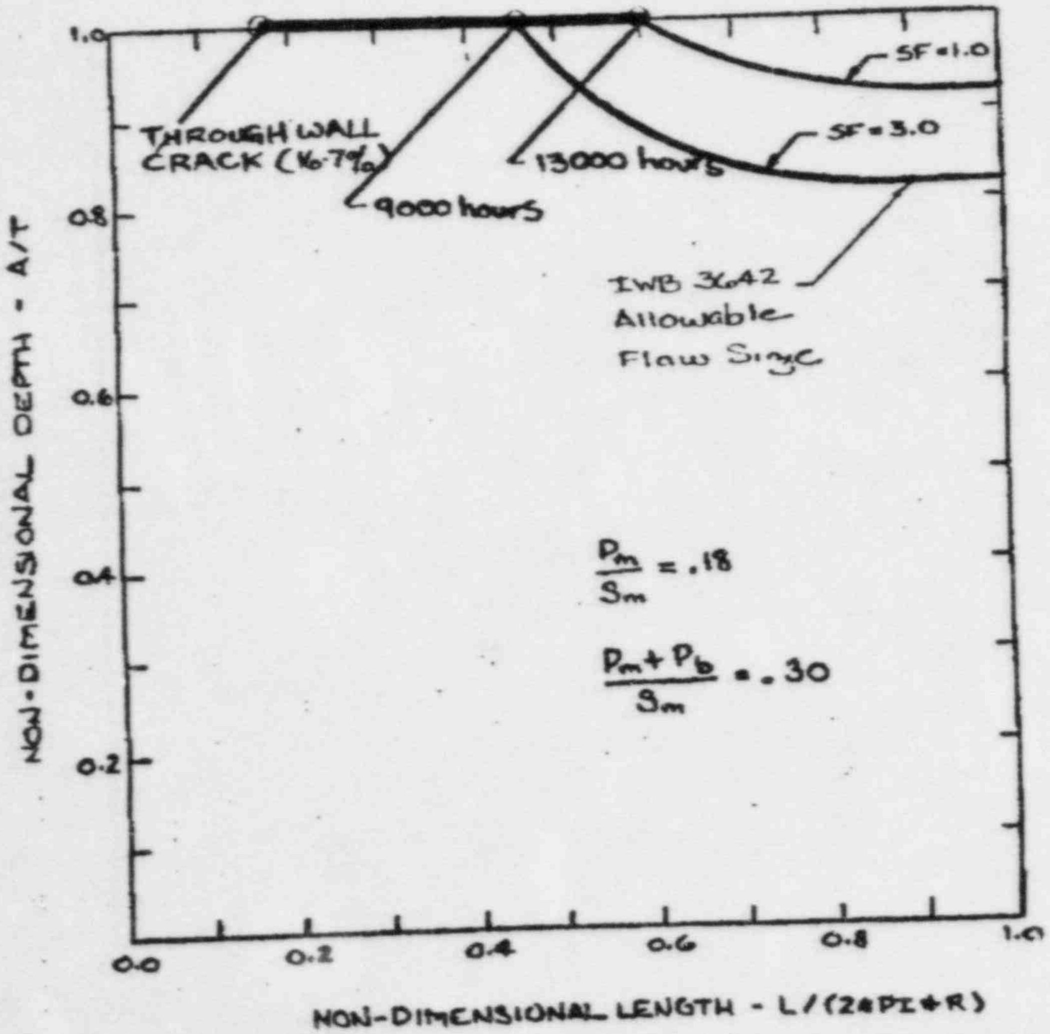
Fig. 4

Peachbottom II

167% Through Wall Flaw Failure Diagram

UPPER BOUND CRACK GROWTH RATE

(2×10^{-4} in/hr)



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