INTERIM REPORT

Accession No. _____

Contract Program or Project Title:

Structural Integrity of Water Reactor Pressure Boundary Components

Subject of this Document:

Same

Type of Document:

Monthly Status Report

Author(s):

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Date of Document:

May 8, 1979

Responsible NRC Individual and NRC Office or Division:

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Prepared for
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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INTERIM REPORT

NRC Research and Technical Assistance Report

(5)

UNITED STATES GOVERNMENT

memorandum

DATE: 8 May 1979

REPLY TO ATTN OF: 6390-120M:FJL:sas

SUBJECT: Monthly Status Report for April 1979

TO: P. Albrecht, Metallurgy and Materials Branch
U.S. Nuclear Regulatory Commission

1. FATIGUE CRACK GROWTH

a. 1T Water Pot - Main matrix test, R=0.2, 1 min ramp/1sec. reset, initial $\Delta K \sim 18$ ksi $\sqrt{in.}$ (~ 20 MPa$\sqrt{m}$), high Mn - Mo weld metal, Linde 0091 flux. Test continues, status excellent, incubation period has passed and crack growth is slow but steady.

b. 1T Autoclave. This device remains out of service pending settlement of internal load cell certification. The autoclave will be rebuilt for use with an external load cell so that testing of the International CCGR round robin specimens may be initiated.

c. 2/4T Autoclave. Main matrix test, R=0.2, one min. ramp, one sec reset, initial $\Delta K \sim 22$ ksi$\sqrt{in.}$, (~ 24 MPa$\sqrt{m}$), current $\Delta K \sim 33$ ksi$\sqrt{in.}$ (36 MPa$\sqrt{m}$), A508 forging material. No measurable growth occurred in April, due to the sustained interruption of February/March. Loads have been slightly increased in an attempt to reinitiate crack growth.

d. Multispecimen Autoclaves

(1) #1. Autoclave being prepared for four specimen daisy chain test. A new clip gage design will be tested on one specimen to determine reliability as compared with LVDT's currently in use.

(2) #2. Four specimen daisy chain, main matrix test, one min ramp, one sec reset, R=0.7. Materials: A508, A533, Mn-Mo weld, A106. Test status excellent, two of four specimens clearly showing some growth. Data not differentiable at present time.

(3) #3. Three specimen daisy chain, preliminary matrix test, 30 min hold, R=0.1. Test continues, status excellent, crack growth data is slow but steady, and not yet meaningfully differentiable.

2. FRACTURE TOUGHNESS

a. During April the primary effort was toward a reanalysis of previous data and installation equipment for the J-R curve facility in a second hot cell.

b. Conclusions reached in this reanalysis are as follows:

(1) The R curve, as generated by the single specimen techniques, is initially rounded and not straight as implied by most investigators heretofore.

(2) The proposed ASTM J_{IC} standard does not effectively address a curved R curve. Consequently, an alternative experimental definition of J_{IC} was devised; its primary use is for short R curves which are terminated by a cleavage instability.

(3) A new definition of upper shelf initiation toughness has been proposed for J_{IC} on the basis of 0.15 mm real crack extension. With further crack extension (over 0.15 mm) it is possible to encounter brittle fracture at some upper shelf temperatures.

(4) Figure 1 illustrates a comparison of pre- vs postirradiation R curve behavior for a high copper weld in the IAR program using nonface-grooved specimens. J_{IC} is defined where the R curve crosses the 0.15 mm inclusion line. The J_{IC} of the irradiated material has dropped by 40%. This translates to a 13% drop in K_{JC} from 162 ksi$\sqrt{\text{in.}}$ to 125 ksi$\sqrt{\text{in.}}$ The latter is below a suggested requirement of 150 ksi$\sqrt{\text{in.}}$ for accident analysis. Analogous to the J_{IC} behavior, the tearing modules has dropped by a factor of 2.3 with irradiation to a value of 35; the tearing modules will be lower for face-grooved specimens.

c. In May we will continue J-R curve tests from weld V86 in IAR program.

3. RADIATION SENSITIVITY AND POSTIRRADIATION PROPERTIES RECOVERY

A. IAR Program Operations: Postirradiation decanning operations stand completed for all Phase 1 IAR experiments.

b. IAR Program Materials Assessments: Postirradiation testing of Cv specimens from all Phase 1 experiments stand completed. Preparation of a report of findings was continued. Neutron dosimetry results for experiments UBR 18 and UBR 19 have not yet been received and are causing some delays.

c. Irradiation of Experiments UBR-23 and UBR-24 containing IAEA reference materials was completed.

d. Irradiation of irradiation/anneal experiment no. was completed.

e. Continued construction of Experiment UBR-25 containing A508-2 forging material (CV, CT specimens). Experiment construction stands 85% completed.

f. Hawthorne and Lukens staff held several telephone conferences on selection of an alternate filler wire melt for Phase 2 IAR investigations. It is hoped that the contract can be let in May. Base plate material for the weldments is scheduled for rolling and heat treatment the second week of May. Weld joint preparation will require at least two weeks of machining time.

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g. Planned for May

(1) Complete construction of Experiment UBR-25 and commence reactor irradiation.

(2) Supervise heat treatment and sectioning of base plate material for Phase 2 IAR Program weldments; commence machining of weld joint preparation.

(3) Select filler wire for Phase 2 IAR welds.

(4) Continue preparation of report on Phase 1 CV IAR Program results.

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Encl: (1)
Fig. 1

Distribution:
C.Z. Serpan, NRC

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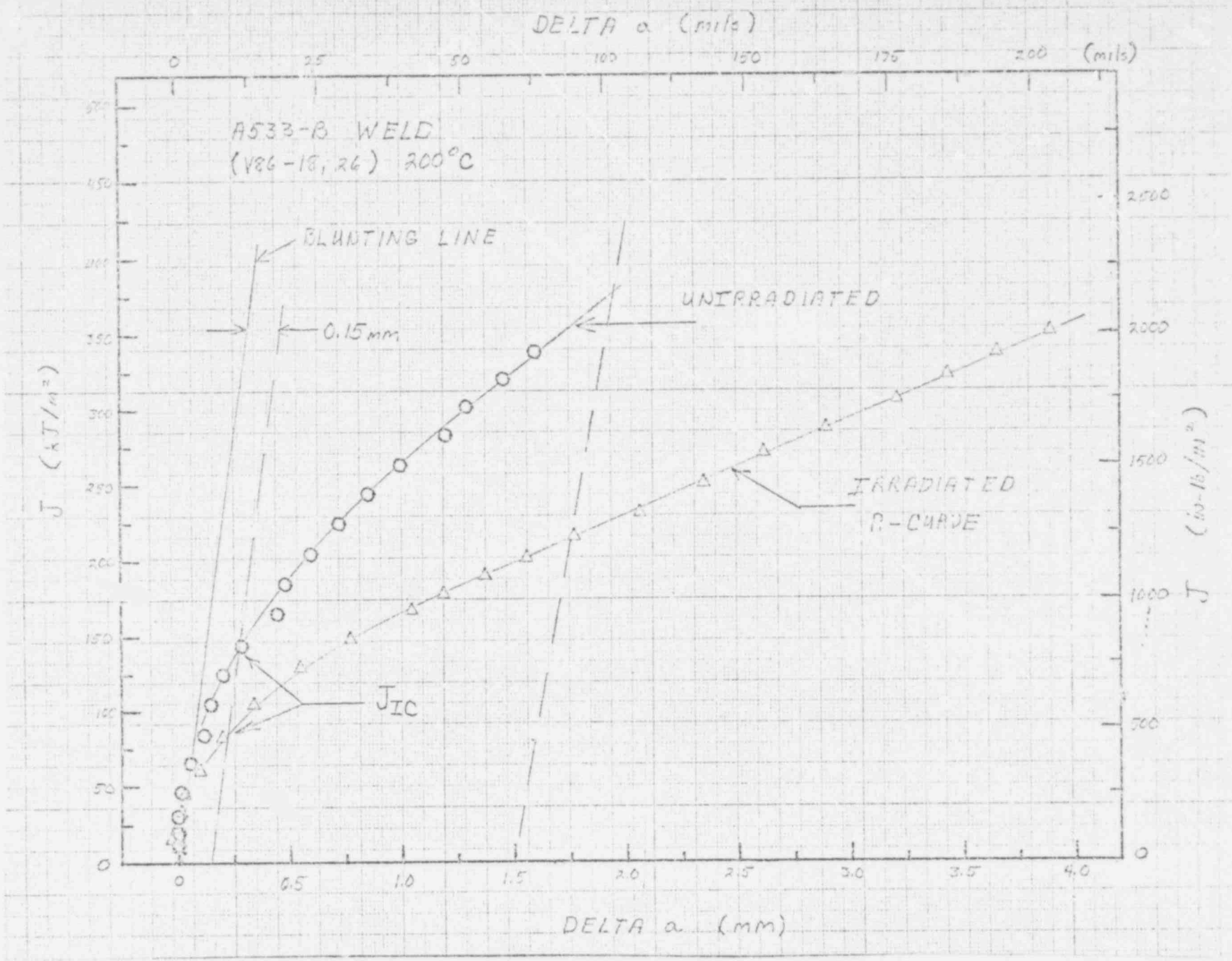

Fig. 1 - Comparison of J-R curves for an A533-B submerged arc weld metal. The R curves have been generated by the single specimen compliance technique with 1T-CT specimens without face grooves.