INTERIM REPORT

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INTERIM REPORT

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June 15, 1979

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Dear Joe:

MONTHLY LETTER REPORT - MAY, 1979
ACOUSTIC EMISSION CHARACTERIZATION OF FLAW GROWTH
IN A533B PRESSURE VESSEL STEEL - FIN. NO. B2088

ACCOMPLISHMENTS

- Completed fracture test of weld metal specimen 2W-1A at 550°F.
- Initiated fatigue crack growth testing in weld metal at room temperature and 550°F.
- Fabrication of pipe specimens and test system was continued.
- Monitored stress corrosion cracking test in 304 s/s pipe.
- Started fabrication of slag inclusion specimen.
- Added a third sensor channel to AE monitor instrument.
- Continued development of a reactor monitor system concept.
- Started preparation of an updated program plan.

Fracture testing of weld metal specimen 2W-1A at 550°F was completed. The specimen was fabricated from ASTM A-533, grade B, class 1 steel supplied by the Heavy Section Steel Technology (HSST) program at Oak Ridge National Laboratory. HSST plate 01NB1 was 12x21x28 inches with a full thickness seam weld centered in the 28 in. width (see Figure 1). Details on the material and welding conditions for plate 01NB1 may be found in References 1 and 2.

The gage section of fracture specimen 2W-1A was obtained by band saw cutting a piece 7x12x28 inches from the original block (Figure 1). Next, approximately one inch thick slabs, designated 2W-1A, 2W-2A, 2W-1B and 2W-2B were removed from the top and bottom "skin" surfaces. Each blank was then machined to enable welding of suitable end tabs (see Figure 2). After welding and finish machining, specimen 2W-1A was notched with a 1/32 in. thick metal slitting saw. The resultant part-circular notch was located in the center of the HSST weld, with dimensions as shown in Figure 2. Next, a fatigue crack was grown from the initial notch to a depth of 0.614 in. and a surface length of 2.2777 in. Finally, the specimen was loaded to failure in a 440 kip Baldwin at a loading rate of about one kip/sec.

A plot of the load and AE count versus crack opening displacement is shown in Figure 3. The AE results up to maximum load are similar in form to data obtained from a previous test run at 550^{o}F on a surface notch base metal specimen (Ref. 3) but the magnitude of data is less for the weld metal. No definite conclusions have been reached at this time as to whether this difference was due to the AE monitoring system or to the microstructural influence of weld metal.

A fatigue crack growth test in weld metal at room temperature and 550^{o}F was started. In view of the unexpected results from the weld fracture test discussed above, extra measures are being employed to substantiate that the AE monitor system has adequate sensitivity and remains stable throughout the test. In addition to the normal calibration and determination of effective sensitivity, a known number of repeatable pulse transient signals are being injected into the specimen at least once each day. These are recorded and identified on the data tape to compare the various signal features from one set to another.

The hydraulic power supply to be used on the impending pipe tests has arrived, with installation and preliminary check-out scheduled for mid-June. Fabrication of the loading frame and test specimens is due to be completed near the end of June. Hopefully, the first test should commence about three weeks later.

A stress corrosion cracking test with 304 s/s pipe performed under another NRC sponsored program was monitored for several weeks with no indication of cracking. The test was terminated and physical examination of the pipe showed that cracking had not occurred. The test did provide beneficial results, however. The lack of AE indications correlated with the lack of cracking. Also, many digitized signal waveforms were recorded for use in pattern recognition investigation. These included noise signals such as electrical transients and signals from the specimen sliding on its support as well as AE signals from stressing the specimen.

The weld specimen received earlier from GATX which was indicated to contain slag inclusions has been machined to remove surface irregulatities and radiographed to obtain a more accurate determination of slag location and configuration.

In anticipation of the more complex configuration of the forthcoming heavy section pipe bend specimen, a third sensing channel has been added to the AE monitor instrument. This will provide more positive source isolation capability for the cylindrical specimen configuration in that it will permit bounding the flaw area on all four sides.

Development of a concept for a reactor monitor system continued. One of the problems being addressed is that of a source location method which is relatively simple and still provides source identification in a circumstance where the specific source area cannot be predefined. The tentative approach being considered is a combination of source isolation to restrict to a general area such as a nozzle together with a "look-up table" which will define sources within that area to smaller resolution elements. A pattern recognition function would operate in parallel with source location to decide if a received signal should be retained.

Development of an updated program plan to encompass the total remaining work toward program objectives is in process. Review of this with NRC staff is scheduled for July.

WORK PLANS FOR JUNE

- Complete fatigue crack growth testing in weld metal at room temperature (RT) and 550°F.
- Complete fabrication of pipe specimens and test system.
- Fabricate slag inclusion specimens.
- Monitor a second 304 s/s pipe stress corrosion cracking specimen.
- Continue development of the reactor monitor system concept.
- Complete an updated program plan.

REFERENCES

1. C.E. Childress, Fabrication History of the First Two 12 in. Thick ASTM A-533 Grade B, Class 1 Steel Plates of the Heavy Section Steel Technology Program, Documentary Report 1, ORNL-4313, Oak Ridge National Laboratory, Oak Ridge, TN, February, 1969.

2. C.E. Childress, Fabrication Procedures and Acceptance Data for ASTM A-533 Welds and a 10 in. Thick ASTM A-543 Plate of the Heavy Section Steel Technology Program, Documentary Report 3, ORNL-4313-3, Oak Ridge National Laboratory, Oak Ridge, TN, January, 1971.

REFERENCES - Continued

3. P.H. Hutton, E.B. Schwenk, and R.J. Kurtz, Acoustic Emission Characterization of Flaw Growth in A533B Pressure Vessel Steel, Monthly Letter Report, February 1979, Battelle, Pacific Northwest Laboratory, Richland, WA, March, 1979.

Yours very truly,

P.H. Hutton

P.H. HUTTON
Project Manager

PHH:dd

Enclosures

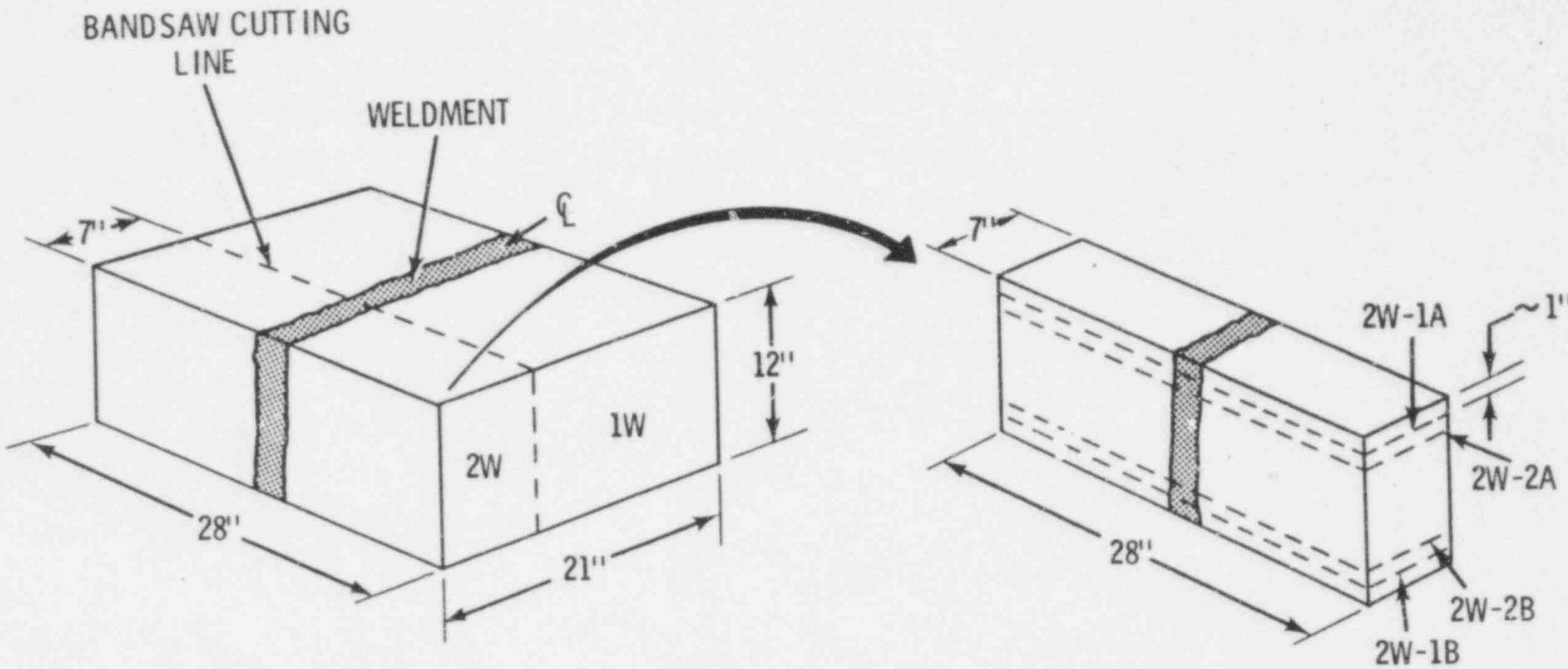

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FIGURE 1. CUTTING DIAGRAM FOR FATIGUE CRACK GROWTH AND FRACTURE SPECIMEN BLANKS.

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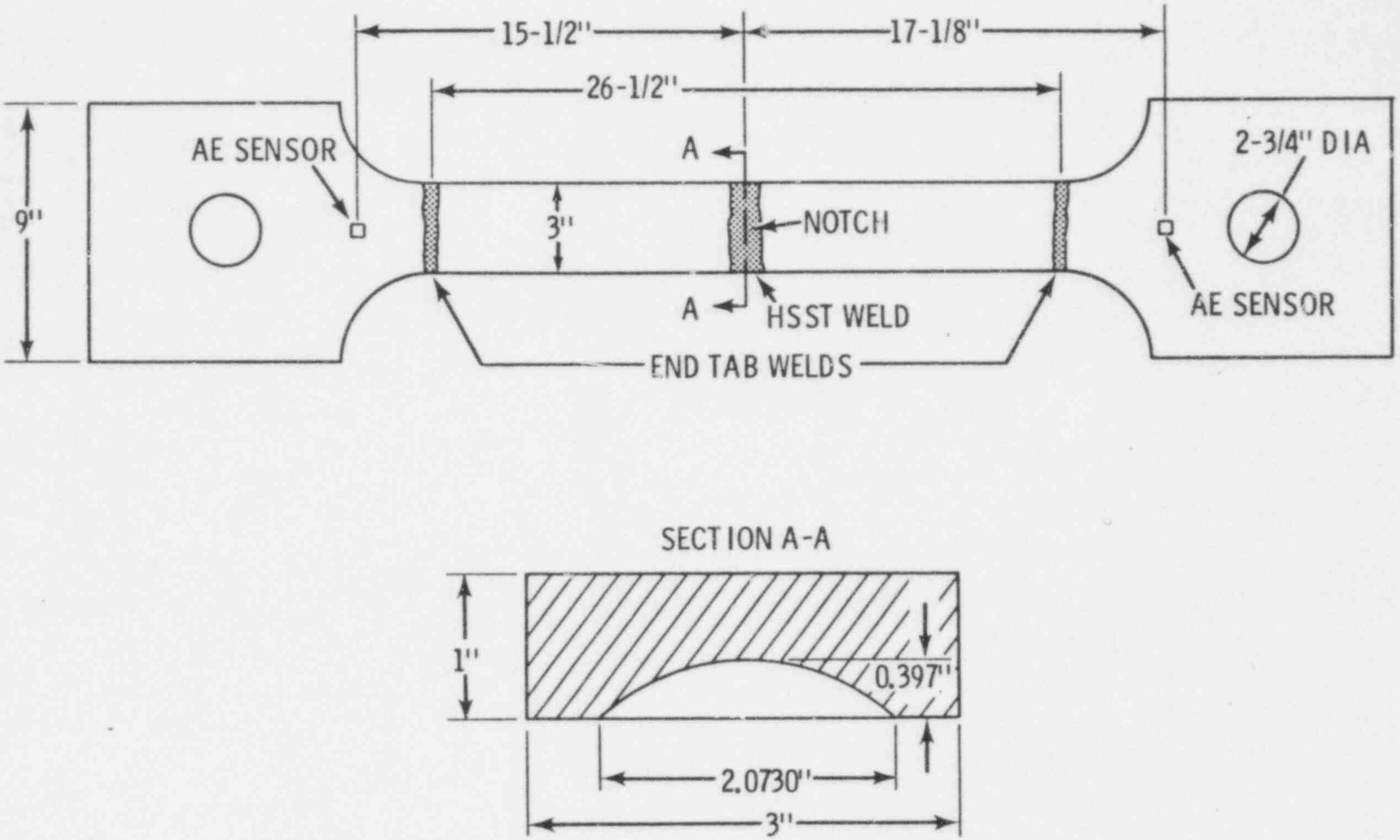

FIGURE 2. SPECIMEN GEOMETRY, NOTCH DIMENSIONS, AND AE SENSOR LOCATIONS FOR SN SPECIMEN 2W-1A.

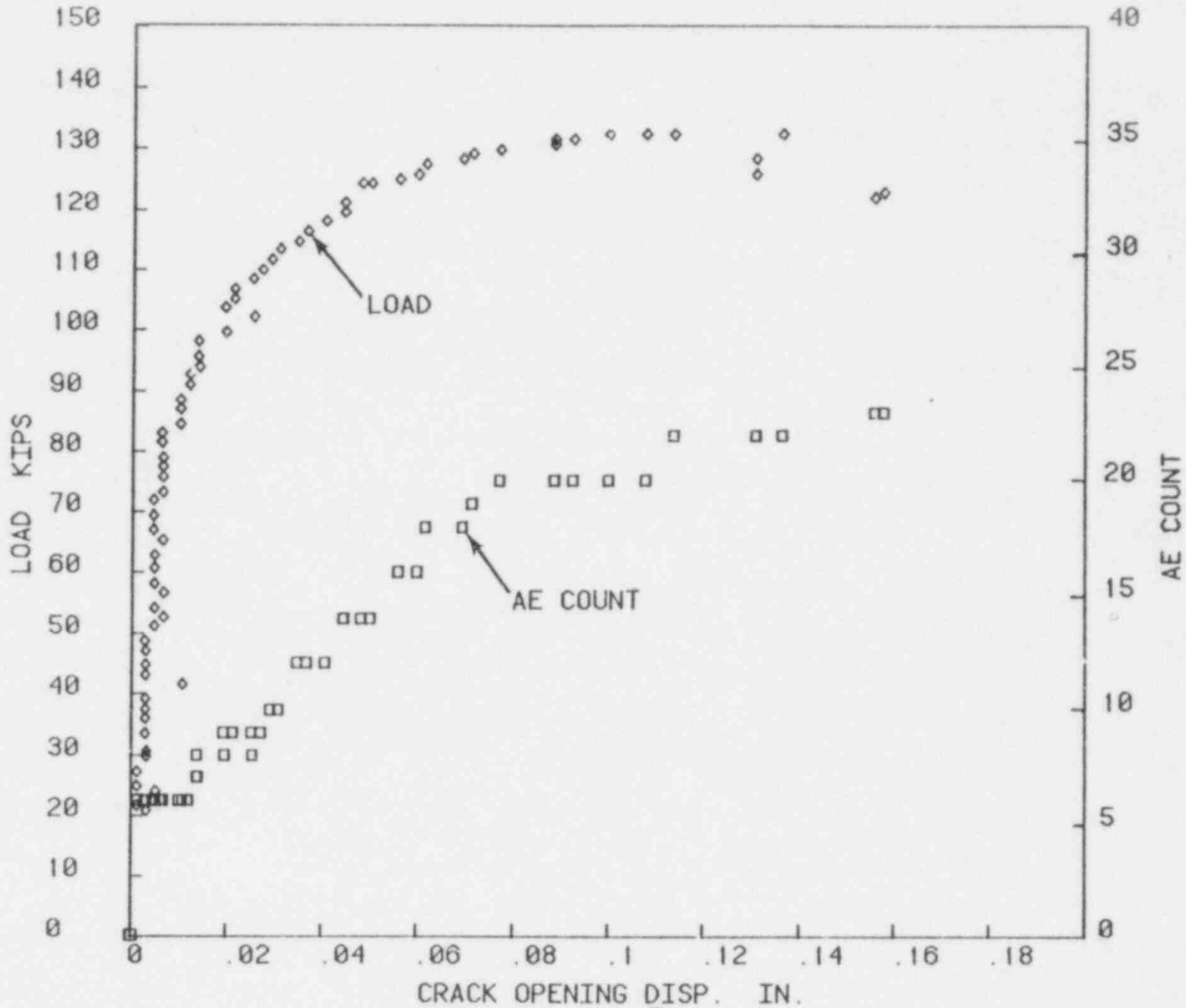

FIGURE 3. LOAD AND AE EVENT COUNT VERSUS COD FOR SN SPECIMEN 2W-1A AT 550°F.