INTERIM REPORT

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INTERIM REPORT

FIN. NO.: B2289

PROJECT TITLE: INTEGRATION OF NDE RELIABILITY AND FRACTURE MECHANICS

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## NOVEMBER MONTHLY REPORT

Highlights of the past month included presentations at the Light Water Reactor Safety Review meeting, completion of Phase I measurements and evaluations and initiation of Phase II activities.

### TASK 1: DRAFT WHITE PAPER

Chapter 12 (Probabilistic Fracture Mechanics) has been written and is presently under review. Chapters 1-6 have been revised and reformated. It is expected that Chapter 1-6 revisions and Chapters 9 and 12 will be distributed in January, 1980.

### Task 2: STATE-OF-PRACTICE REVIEW

It is expected that this report will be completed during the month of December, 1979.

### Task 3: ANALYSIS BEFORE TEST DOCUMENT

The Phase I document was completed. It is expected that the Phase II Analysis Before Test Document will be completed during January, 1980.

### Task 4: FRACTURE MECHANICS

Fracture mechanics evaluations concerning required NDE sensitivity have been completed and will be covered in detail in the Phase I topical report. The results of this analysis agree with the results of the Battelle Columbus analysis in that leak before break is postulated for all cases. To establish the required NDE sensitivity, we selected the criteria that no flaw should grow beyond 50% of through wall thickness during an inspection interval (10 years). Based on this 50% criteria, NDE systems would be required to have a high probability of detection for flaws in the 20 to 30% range.

### Task 5: STATISTICAL ANALYSIS

The two objectives of this task are analysis of Phase I data and test matrix development for Phase II round robin inspections. Phase I data analysis has been completed and estimates of the influence of inspection variables have been made. Principal conclusions from this study are as follows:

1. Search unit diameter must be controled to achieve repeatable results and suitable inspection sensitivity.

2. The 100% DAC reporting level and 50% DAC recording level are insufficient to assure adequate detection sensitivity.

3. Amplitude only detection is highly variable and not indicative of flaw severity.

The test matrix for the Phase II round robin tests has been defined. However, it may be necessary to revise the matrix to be consistent with available funding.

Task 6: SAMPLE PREPARATION

The first 10 inch, Sch. 80 pipe has been completed, with 10, 20 and 50% cracks. Coupling of the water jet nozzles to the pipe ID at the weld proved to be less of a problem than anticipated and the procedure was carried out without incident.

Task 7: MEASUREMENT AND EVALUATION

Phase I experiments on crack orientation and crack tightness have been completed and the analysis will be reported in the quarterly and topical report, presently in progress.

During a recent visit by John Whittle of the Central Energy Generating Board (CEGB), Manchester, England, we learned that they are also performing experiments on the effects of crack tightness. Low alloy steels typical of ferritic piping are being used in their experiments. The results are very similar to ours in that 20 to 30 dB loss of signal amplitude can occur due to crack tightness. They also measured the loss of signal due to water in the crack and the effect of crack roughness over the range of 10 to 40 micons RMS. Smooth cracks exhibited the largest change in amplitude due to crack tightness. They also showed that crack roughness was directly proportional to the $\Delta K$ of the fatigue process. Their report will be published shortly and should help to substantiate our results. They have also made an evaluation of the influence of surface (entry coupling surface) roughness on inspection reliability. We should receive a copy of this report shortly.

Baseline digital data collection is in progress on the 10 inch, Sch. 80 pipe. This effort was delayed due to difficulties with the pipe scanner at MEDL. The first cracked pipe will also be inspected within the next week.

We have recently taken frequency domain information as a function of crack tightness. The spectral frequency response of the crack is definitely affected by crack tightness. This is reasonable according to theory, as transmission through the crack is dependent on the wave length. Further experiments will be required to determine what influence this will have on efforts to size and detect cracks based on frequency domain information.

PHASE II EFFORT

Efforts are in progress to acquire PWR main coolant pipe samples. Several surplus pieces of B&W pipe were purchased by EPRI from the Mt. Vernon plant in Ohio. We are currently discussing obtaining some of this material from Dr. Dau at EPRI. This effort looks promising. We have also contacted several piping fabricators

to initiate arrangements for welding. Initial ballpark estimates for welding and cladding three pipes were from $30K to $50K from B&W Barbarton. These estimates seem to be very high. Efforts will be made to obtain more reasonable estimates and delivery schedules.

FUTURE WORK PLANS

Efforts during the month of December will be directed toward completion of the Phase I topical report, the Phase II Analysis Before Test Document and finalizing arrangements for Phase II welded samples.