INTERIM REPORT

Accession No. _____

Contract Program or Project Title: ACOUSTIC EMISSION/FLAW RELATIONSHIPS FOR INSERVICE MONITORING OF NUCLEAR PRESSURE VESSELS

Subject of this Document: MONTHLY PROGRESS - OCTOBER 1980

Type of Document: INFORMAL LETTER REPORT

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Date of Document: NOVEMBER 21, 1980

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INTERIM REPORT

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November 24, 1980

Dr. Joe Muscara
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Dear Joe:

MONTHLY LETTER REPORT - OCTOBER, 1980
ACOUSTIC EMISSION CHARACTERIZATION OF
FLAW GROWTH IN A533B PRESSURE VESSEL STEEL
FIN. NO. B2088

ACCOMPLISHMENTS

- Achieved tentative arrangements for fabrication of A533 insert for vessel test.
- Preliminary results obtained on reactor flow noise simulation.
- Reviewing AE system calibration plan.
- Finalized pattern recognition approach for the vessel test.
- Continued contact with TVA on reactor installation of AE system.
- Preparation for irradiated fracture specimen monitoring
- Continued AE monitor system fabrication.
- Started development of improvements to sensor noise rejection capability.
- Participated in 8th Water Reactor Safety Research Review Meeting.

Vessel Test

A final set of requests for bid on fabrication of the A533 insert for the ZB-1 vessel test resulted in no response from any of the U.S. concerns. MPA, Stuttgart, West Germany has, however, indicated that they will fabricate the insert. Preliminary estimates are about $50K and 20 weeks to do the work. A formal bid is expected from MPA by November 21.

Preliminary results have been obtained on simulation of reactor flow noise for use on the ZB-1 vessel test. Two approaches are being investigated - electronic and hydraulic.

Feasibility of electronic simulation has been established. A broad band diode noise generator was used in conjunction with shaping filters to produce a good replica of measured reactor noise as seen by an AE sensor. The power input to the transmitting transducer was substantially less than anticipated.

Noise simulation by hydraulic means is still unresolved. An initial test involving throttling water flow through a 12 inch O.D. by two inch wall by 36 inch long autoclave vessel using an existing globe valve was not successful. A gate valve is being installed in the supply line to determine if it will more effectively produce cavitation during throttling of the flow.

The proposed AE sensor and system calibration procedure received from IZFP, Saarbrucken (Drs. Deuster and Lottermoser) has been partially reviewed. The modification we are proposing at this point is concerned with basic sensor calibration. IZFP proposes a reciprocity method. We feel that this should be supplemented with primary or secondary calibration traceable to the U.S. National Bureau of Standards.

The approach to be used in applying pattern recognition to the ZB-1 vessel test has been finalized. The criteria for constructing the vessel test decision rule assumes that there will be many fewer flaw signals compared to innocuous noise in an operating reactor environment. Therefore, it is important to identify all of the flaw signals at the expense of misclassifying a higher percentage of the noise signals. An overall success rate of 75% would be acceptable if close to 100% of the flaw AE were accepted. The noise signals could then be screened out by other means such as source location. The primary sensor to be used in the test will be the waveguide. Analysis of the composite data has shown us that the decision rule should be "calibrated" on data from the sensor that will be used. Therefore, the parameters for the decision function and decision rule will be fit from the available waveguide data. A block diagram of the pattern recognition implementation method is shown in Figure 1.

During vessel testing, there will be neither time nor core space on the computer to do a fundamental pattern recognition analysis of the data, that is, to test features and develop decision rule improvements. We will do the developmental analyses at PNL. The computations to be done on-site are only the essentials needed to evaluate the decision rule and make the flaw growth AE-noise discrimination.

Reactor Installation

In telephone conversation with Ed Merrick, TVA Design Engineering Division, he stated that he had preliminary approval from TVA management to install an AE test system on Watts Bar, Unit 1 reactor, Formal approval should be forthcoming in a few weeks. When this is achieved, the next steps will be for PNL to prepare a test authorization document for appropriate TVA approvals and visit the site to obtain detail information on sensor system installation.

Irradiated Fracture Specimen Tests

Following notification from Henry Watson, NRL, that preparation for testing irradiated fracture specimens was starting, J.F. Dawson, PNL, visited NRL on October 7. The purpose of the visit was to gather detailed information on requirements and limitations associated with AE monitoring specimen tests. The necessary sensor mounting fixtures have been assembled in preparation for testing. We will use magnetic mounting fixtures and a high temperature couplant (Pyrogel) to facilitate positioning the sensors on the irradiated specimens using remote manipulators.

AE Monitor System

Software programming for the waveform recording subsystem is essentially completed and the subsystem is ready for packaging. The major remaining task to complete the AE monitor system is interfacing the D/E 1032 detection/source location system to the PDP 11/03 computer.

Sensor System Improvements

A task has been initiated to improve the noise rejection capabilities of our AE sensors and preamps. By virtue of their design, the present sensors are influenced by changes in the electric potential of the structure being monitored. Hence, ground loops or other electrical noise can cause spurious signals. These problems can be overcome by using a differential preamplifier with a single-ended sensor. This design provides an additional electrical shield between the AE signal and external electrical influences.

A trial model of a special sensor on a waveguide was fabricated to demonstrate feasibility. It was very successful at shielding out a 20 volt sinusoidal variation in the potential of the steel waveguide itself. Based on this success, three prototype sensors are being

fabricated for evaluation; two will be on waveguides; one will be a contact style.

Parallel with the sensor development is the designing and testing of a suitable differential preamplifier. Our schedule calls for the packaged waveguide sensor and preamplifier to be fabricated for initial evaluation by mid-December.

Program Review

Program accomplishments and status were presented at the Eighth Water Reactor Safety Research Information Meeting, Gaithersburg, MD, October 31.

Schedule

Program schedule status is shown in Figure 2. Fabrication of the A533 insert and assembly of the test vessel continue to be the key items of concern. Progress is being made, however, toward resolving the insert fabrication as discussed under "Vessel Test" above. Also, the last word from MPA, Stuttgart, indicated that they expected to resolve vessel fabrication problems in November.

Funding

In Table 1, the current allocation of FY-80 carryover funds together with FY-81 funds is summarized.

WORK PLANNED FOR NOVEMBER

- Continue efforts on A533 insert fabrication.
- Continue contact with TVA on reactor installation.
- Continue AE monitor system fabrication.
- Complete investigation of reactor flow noise simulation.
- Perform characterization tests of A508 specimens.
- Arrange to visit MPA, Stuttgart, West Germany, regarding vessel test details and IZFP, Saarbrucken, regarding weld monitor demonstration in conjunction with other business in Europe.

Yours very truly,

P. H. Hutton

P.H. HUTTON
Project Manager
Nondestructive Testing Section

PHH:dd

Attachments

TABLE 1

SUMMARY OF FUNDING 11/1/80

NRC AE/FLAW CHARACTERIZATION PROGRAM
FIN. NO. B2088

Total Funding:	Expense - FY81		$500.0K
	- FY80 Carryover		122.0K
		Total	$622.0K
	Capital - FY81		$ 30.0K
	- FY80 Carryover		14.4K
		Total	$ 44.4K
Status 11/1/80:	Expense - Spent*		$ 21.9K
	Balance		600.1K
	Capital - Spent*		$ 9.6K
	Balance		34.8K

*Includes outstanding commitments

Planned Commitment of Balance

Expense

Vessel Test - Fabricate and Deliver A533 Insert		$ 65.0K
- Test A508 Specimens		15.0K
- Analysis-Before-Test Document		5.0K
- General Preparation		10.0K
- Noise Simulation Development		10.0K
- Test and Analysis		250.0K
Irradiated Fracture Specimen Monitoring		30.0K
AE Monitor System Fabrication and Testing		50.0K
Reactor Installation of AE Sensing System		30.0K
HSST Test Monitoring		20.0K
Weld Monitor Demonstration		20.0K
Pattern Recognition Refinement		25.0K
Reporting, Program Management, Travel		70.0K
	Total	$600.0K

Capital:

AE Monitor System		$ 4.8K
COD Gauges, Signal Conditioning Equipment		30.0K
	Total	$ 34.8K

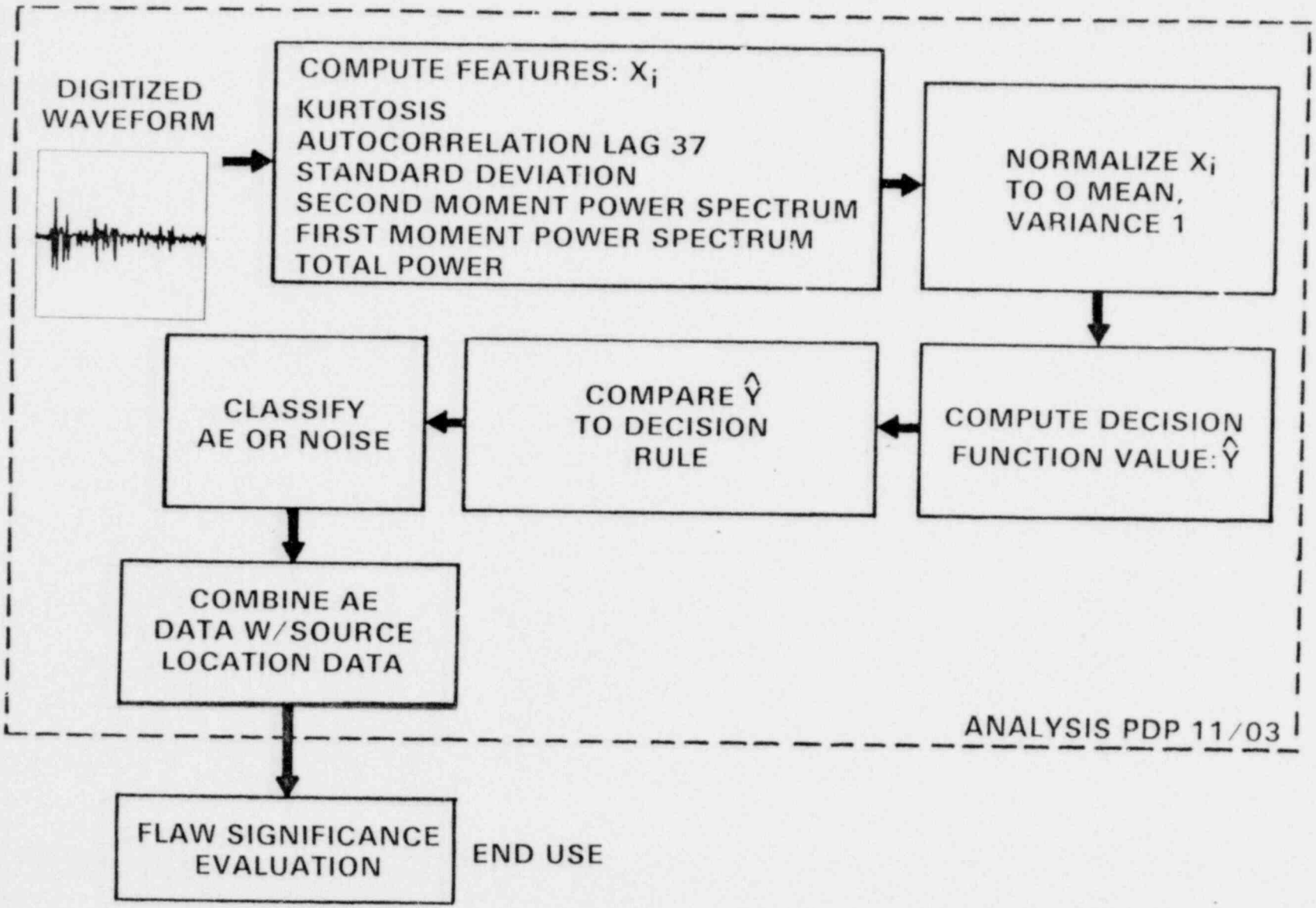
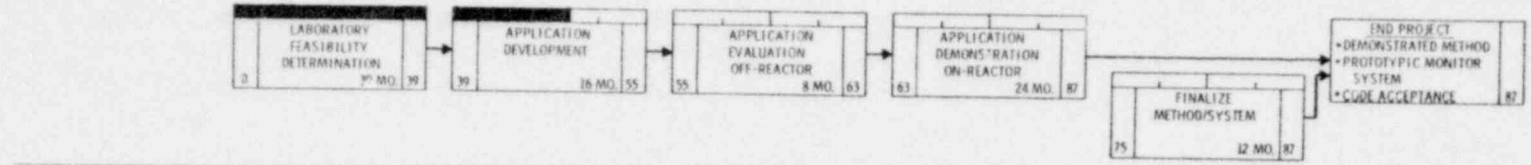
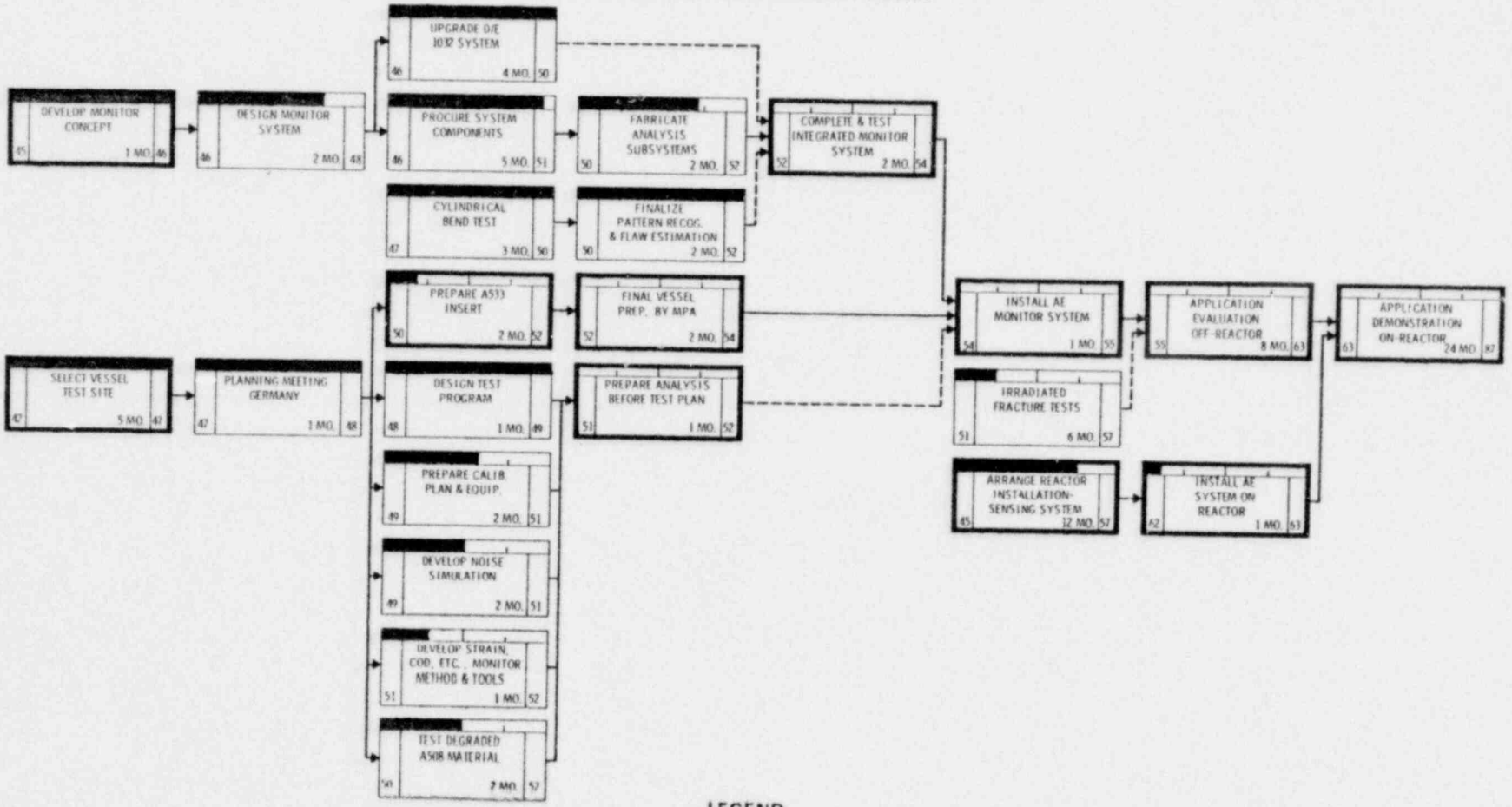


FIGURE 1. PATTERN RECOGNITION IMPLEMENTATION.

SCHEDULE AND MILESTONES FOR NRC AE/FLAW CHARACTERIZATION PROGRAM, FIN. #B2088



APPLICATION DEVELOPMENT-DETAIL



LEGEND

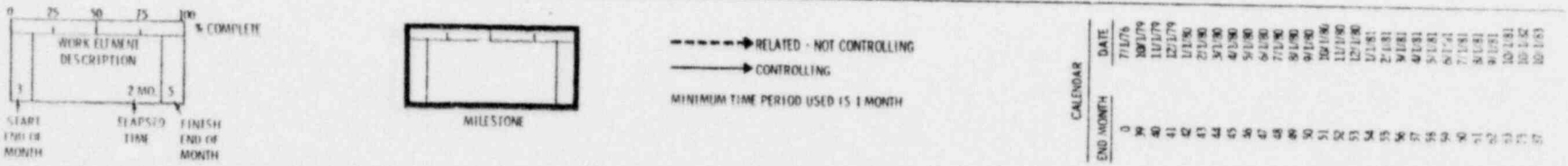


FIGURE 2. PROGRAM SCHEDULE.

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Monthly Letter Report - October 1980
Acoustic Emission Characterization of Flaw Growth in A533B Pressure Vessel Steel
Fin. No. B2088

4. AUTHORS (If more than three, name first author followed by "and others.")

P. H. Hutton, R. J. Kurtz

5. ORGANIZATIONAL UNIT (If contract, give organizational unit of author to whom inquiries may be addressed.)

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6. REPORT DATE(S)	BASIS FOR EACH DATE (e.g. date manuscript submitted; date manuscript published.)
November 21, 1980	Date report completed and mailed to NRC

7. CONTRACT NUMBER	8. NAME OF NRC PROGRAM SPONSOR FOR CONTRACT	TELEPHONE NO.
	Dr. Joe Muscara Metallurgy & Materials Res. Br. RSR	(301)427-4262

9. TYPE OF DOCUMENT ("X" one)

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12. OELD CLEARANCE	13. SUBMITTED BY
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	b. ORGANIZATIONAL UNIT Nondestructive Testing
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c. PATENT COUNSEL'S SIGNATURE	d. SIGNATURE (NRC responsible staff member) P. H. Hutton
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