

SUPPLEMENTAL AGREEMENT
BETWEEN
THE UNIVERSITY OF MICHIGAN
AND
THE U. S. NUCLEAR REGULATORY COMMISSION

THIS SUPPLEMENTAL AGREEMENT, effective the 1st day of October , 1978, by and between the UNITED STATES OF AMERICA (hereinafter referred to as the "Government"), as represented by the UNITED STATES NUCLEAR REGULATORY COMMISSION (hereinafter referred to as the "Commission"), and THE UNIVERSITY OF MICHIGAN (hereinafter referred to as the "Contractor"),

WITNESSETH THAT:

WHEREAS, the parties desire to modify Contract No. NRC-04-75-182 as hereinafter provided, and this supplemental agreement is authorized by law, including the Energy Reorganization Act of 1974, as amended, and the Atomic Energy Act of 1954, as amended.

NOW, THEREFORE, said contract is hereby modified as follows:

1. Appendix A, attached to this supplemental agreement and made a part hereof, provides for the research to be performed by the Contractor during the contract period specified therein.
2. In Article II - The Period of Performance, the date "September 30, 1979" is substituted for the date "September 30, 1978".
3. In Article III - Consideration, the sum "\$728,671.00" is substituted for the sum "\$491,317.00".

IN WITNESS WHEREOF, the parties have executed this document.

UNITED STATES OF AMERICA

BY: *Kellogg V. Morton*

Kellogg V. Morton, Chief
Research Contracts Branch
(title)

Nuclear Regulatory Commission

UNIVERSITY OF MICHIGAN

BY: *C. W. Matthews*

C. W. Matthews, Controller
(title)

I, Paul J. Stemple, certify that I am the Manager
(attester)

Office of Contract Administration of the Contractor named
(title)

under this document; that C. W. Matthews
(signatory)

who signed this document on behalf of said Contractor was then

Controller of said Contractor; that
this document was duly signed for and on behalf of said Contractor by
authority of its governing body and is within the scope of its legal
powers.

IN WITNESS WHEREOF, I have hereunto affixed my hand and the seal of
said Contractor.

Paul J. Stemple
Paul J. Stemple, Manager
Office of Contract Administration

(SEAL)

CONTRACTOR: UNIVERSITY OF MICHIGAN :-

APPENDIX A

For the Contract period October 1, 1978 through September 30, 1979

Article A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

- (a) The scope of work under this contract is unclassified and shall be in accordance with Contractor's proposal entitled, "Improved Ultrasonic Nondestructive Testing of Pressure Vessels," DRDA 78-2029-PI, incorporated by reference and made a part hereof including the following tasks:

1. SPOTLIGHT MODE SAFT UT

The initial assessment of the ability of spotlight mode SAFT UT to perform high-resolution imaging in FY-78 will be expanded into a methodical study in order to optimize resolution by studying the effects of aperture size, wave mode, and attenuation due to refraction, scattering, and absorption. The results of the study will be experimentally verified with heavy-section and stainless steel samples.

2. DEVELOPMENT OF A CALIBRATION TECHNIQUE

Develop a computer program to generate ideal data sets and determine the effect of the data and processing parameters on the system output. Fabricate test blocks for comparison of real and ideal data. From the comparisons develop a technique for quantitatively measuring the overall performance of an ultrasonic synthetic aperture system.

3. SYSTEMATIC STUDY OF SCANNING AND PROCESSING PARAMETERS AND SYSTEM EVALUATION

Perform a systematic quantitative study of the effects of the parameters used in the scanning and processing routines of the SAFT UT system. Evaluate speed/resolution trade-offs. Qualitatively determine minimal system requirements using previously obtained data and relaxed input parameters.

4. SURVEY MODE INSPECTION

Implement a preliminary survey mode inspection scheme using matched filters and pattern recognition routines to extract and classify reflectors as being either flaws or non-flaws. Based on the results of this scheme determine the suitability of the method in terms of potential speed and potential for correctly recognizing the presence of flaws.

5. DEVELOPMENT AND IMPLEMENTATION OF "SQUINT" PROCESSING

Synthetic aperture processing algorithms will be developed to allow off-axis ("squint") focusing. Tests will be made to determine the improvement in near-surface imaging ability of squint SAFT UT over conventional SAFT UT. Tests will be made on cast stainless steel samples.

6. UPGRADING OF THE PRESENT LABORATORY SYSTEM

Increase the efficiency of the laboratory SAFT UT system by making the following improvements:

- a) design and install a hard-wired signal averager.
- b) modify electronics and software to perform data acquisition during search unit movement
- c) investigate more efficient data structures and implement as appropriate
- d) install a local memory in the gray scale system.

GRAPHICAL DISPLAY OF FLAWS

Acquire a color graphics display terminal having 512 x 512 screen resolution and 64 intensity levels. Implement existing software on the new unit. Develop new interactive software to determine the best way of exploiting color as a fourth dimension. Develop software to display three-dimensional images of flaws at arbitrary angles on the gray scale display unit. Finally, review previously obtained data and determine to what extent these new methods aid in accurate flaw characterization.

8. PIPE SCANNING ALGORITHM

Develop programs to move the five-axis scanner over a pipe surface. Implement these programs and test them on a stainless steel pipe sample.

9. FIELD IMPLEMENTATION SUPPORT

The University of Michigan will provide technical and analytical support to the Southwest Research Institute in its program for actively pursuing the implementation of the SAFT UT techniques for preservice and inservice inspection. Such support may include experimental evaluation of proposed scanning and data acquisition parameters at the University of Michigan. Analytical analysis of particular component geometries will be provided along with the resulting processing software modifications.

10. ASME CODE PARTICIPATION AND MONITORING OF PRESSURE VESSEL NDE RESEARCH

- a. Continue to participate in the NDE activities of ASME Boiler and Pressure Vessel Code Section XI for upgrading of present code rules and to monitor the activities of Sections III and V. Provide trip reports, oral reports, and consultation on same to the Nuclear Regulatory Commission.
- b. Monitor domestic and foreign NDE research. Prepare a topical report summarizing major domestic and foreign R and D programs in pressure vessel NDE and research needs. Provide oral reports and consultation on same.

11. REPORTING

- a) Monthly letter progress reports are required.
- b) Quarterly progress reports are required.
- c) Trip reports from tasks 9 and 10 are required. These can be separate reports or combined with the monthly or quarterly reports, as appropriate.
- d) Topical reports on tasks 1 through 8 are required. Separate reports can be submitted for individual tasks or several tasks can be combined in fewer topical reports, as appropriate.

- (b) The Principal Investigator expects to devote the following approximate amount(s) of time to the contract work:

15% of his time during academic year and
2 months in summer

ARTICLE A-II WAYS AND MEANS OF PERFORMANCE

- (a) Items for which support will be provided as indicated in A-III, below

- | | |
|---|--------------|
| (1) Salaries and Wages | \$ 96,969.00 |
| (2) Equipment to be purchased or
fabricated by the Contractor
Items expected to cost in excess of \$1,000.00 | \$ 28,000.00 |
| a. Color Graphics Terminal | |
| b. Graphics Terminal | |
| (3) Travel | |
| (i) Domestic | \$ 5,450.00 |
| (ii) Foreign | \$ 2,900.00 |
| (4) Other direct costs, including fringe benefits | |
| (5) Indirect costs based on a predetermined rate of 74 percent applicable
to Wages and Salaries and fringe benefits. | |

- (b) Items, if any, significant to the performance of this contract, but excluded from computation of Support Cost and from consideration in proportioning costs:

NONE

- (c) Time or effort of Principal Investigator(s) including indirect costs and fringe benefits contributed by Contractor but excluded from computation of Support Cost and from consideration in proportioning costs:

5% of Principal Investigator's time
during academic year.

Article A-III

The total estimated cost of items under A-II(a) above for the contract period stated in this Appendix A is \$237,354.00 ; the Commission will pay 100 percent of the actual costs of these items incurred during the contract period stated in this Appendix A, subject to the provisions of Article III and Article B-XXVIII. The estimated NRC Support Cost for the contract period stated in this Appendix A is \$237,354.00 .

The estimated NRC Support Cost is funded as follows:

- | | |
|---|---------------|
| (a) Estimated unexpended balance from prior period(s) | \$ -0- |
| (b) New funds for the current period | \$ 237,354.00 |
| (c) The new funds being added in A-III(b) constitute the basis for advance payments provided under Article B-X. | |