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

THIS SUPPLEMENTAL AGREEMENT, effective the 1st day of January , 1981, 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 " December 31, 1981 " is substituted for the date " December 31, 1980 ".

3. In Article III - Consideration, the sum "$1,256,909.00" is substituted for the sum "$959,921.00".

IN WITNESS WHEREOF, the parties have executed this document.

UNITED STATES OF AMERICA

BY: _____
Kellogg V. Morton, Chief
Research Contracts Branch
Division of Contracts
U. S. Nuclear Regulatory Commission

University of Michigan

BY: _____
J.F. Brinkerhoff, Vice President and Chief Financial Officer
(title)

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

Manager of Contract Administration of the Contractor named under this
(title)

document; that J.F. Brinkerhoff who signed this
(signatory)

document on behalf of said Contractor was then Vice President and Chief Financial Officer

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

(SEAL)

CONTRACTOR: University of Michigan

APPENDIX A

For the Contract period January 1, 1981 through December 31, 1981

Article A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

(a) The unclassified scope of work under this contract entitled, "Improved Ultrasonic Nondestructive Testing of Pressure Vessels" is as follows:

Second Year Scope of Work

Task I - Design, implement and evaluate a prototype of a real-time SAFT-UT imaging system for field implementation.

1. Design several solutions to overcome the real-time bottlenecks identified in FY 1980.

2. Compare these against each other and choose the one best suited, taking into account factors such as cost, reliability, ease of field implementation of a prototype, etc.

3. Write a report on the results and the outline of the design.

Task II - Design and implement methods for enhanced graphical display of flaws to provide better interpretability.

1. Complete the investigation and design of techniques to display separate planes within an inspection volume to provide a "walk-through" effect.

2. Implement the best technique for the "walk-through" effect and compare it against the best continuous tone shading technique using actual flaws.

3. Initiate study on real-time rotation techniques and their computational requirements.

4. Write a report on the findings to date on these techniques and evaluations.

Task III - Quantitative characterization of the synthetic aperture processing system to enable characterization of flaws and improve the extraction of information in the signal.

1. Continue the qualitative characterization work begun in FY 1980 to obtain quantitative results which will aid in the determination of parameters (scanning resolution, digitizing interval, transducer characteristics) for a field implementable system.

2. Evaluate the effects of noise, random surface variations and position errors on the point spread function.

3. Write a report on all of the above.

Task IV - Develop methods for the imaging of weak reflectors near a front surface. Evaluate the relative merits of these methods on the basis of test results from reactor-type materials specimens with real flaws.

1. Continue development, evaluation and implementation of the signal subtraction technique.

2. Continue development, evaluation and implementation of the deconvolution technique.

3. Continue development, evaluation and implementation of the spatial filtering technique.

4. Evaluate the relative merits of the three techniques and write a final report on this task with recommendations.

Task V - Design, develop and implement methods for the automatic detection of flaw boundaries in an ultrasonic image which have less or no dependence on interpretation by an operator. Develop techniques for image interpolation to adjust for decreased scanning resolution in X and Y (compared to Z) directions.

1. Continue the evaluation and implementation of various two dimensional edge operators on ultrasonic images.

2. Design and implement boundary detection programs using the dynamic thresholding method of edge extraction based on local image statistics for the detection of flaw boundaries.

3. Compare the various methods using real flaws, and write a report on the results with guidelines for future study and implementation of these techniques.

Task VI - Perform synthetic aperture imaging with shear waves.

1. Complete the evaluation of squint mode SAFT imaging system with longitudinal waves on steel samples containing actual flaws.

2. Develop and implement the squint mode SAFT with shear waves.

3. Begin to test these algorithms using squint mode and shear waves on actual weldments with flaws and in clad steel plates with under-clad cracks.

4. Write a report on the results of this study.

Task VII - Improve and further develop the survey-mode detection system.

1. Obtain and test stainless steel and carbon steel samples containing real flaws and perform multidimensional data analysis on the scan signals.

2. Test the optimal flaw detection scheme developed in FY 1980 on the above samples.

3. Based on the above experiments, implement a flaw detection algorithm.

4. Study the computational requirements and make a recommendation on details of field implementation.

5. Write a report on the above findings.

Task VIII - Evaluate the spotlight mode scanning technique for possible field implementation.

1. Investigate the feasibility and need for spotlight mode scanning of heavy section steel.

2. Compare the results obtained in FY 1980 with conventional SAFT and propose guidelines for use of spotlight mode in the field.

3. If results of above are promising, start planning investigation into the design of fast spotlight mode scanning.

4. Write a report on above findings.

Task IX - System upgrade and improvements.

1. Analyze the needs for the project in terms of equipment and facilities. Modernize the laboratory to increase reliability and performance by exploiting the trend in decreasing hardware costs of computer peripherals and equipping it with cost effective equipment.

Task X - Monitoring NDE research and cooperation with other organizations.

1. Monitor the research in advanced UT techniques for NDE by attending meetings, conferences, etc., and provide frequent written reports to NRC on these.

2. Provide technical, analytical and other support to the SWRI research group conducting the NRC SAFT-UT field implementation program. Meet with this group frequently (8 times a year, alternating sites) to exchange ideas and results to enable the smooth transfer of technology and results into the field for field implementation.

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

Dr. S. Ganapathy, Principal Investigator, 70% of his time for nine (9) months plus three (3) summer months.

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 $ 129,633.00

(2) Equipment to be purchased or fabricated by the Contractor $ - 0 -

(3) Travel
(i) Domestic $ 12,000.00

(ii) Foreign $ 3,000.00

(4) Other direct costs including fringe benefits.

(5) Indirect costs based on a predetermined rate of 18 percent applicable to salaries and wages.

(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:

None

Article A-III

The total estimated cost of items under A-II(a) above for the contract period stated in this Appendix A is $296,988.00 ; 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 $296,988.00 .

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 $ 296,988.00

(c) The new funds being added in A-III(b) constitute the basis for advance payments provided under Article B-X.