Modification No. 3
Supplemental Agreement to
Contract No. NRC-04-78-271

SUPPLEMENTAL AGREEMENT
BETWEEN

ARIZONA BOARD OF REGENTS
AND
THE U. S. NUCLEAR REGULATORY COMMISSION

THIS SUPPLEMENTAL AGREEMENT, effective the 1st day of June , 1980, 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 ARIZONA BOARD OF REGENTS.
(hereinafter referred to as the "Contractor"),

WITNESSETH THAT:

WHEREAS, the parties desire to modify Contract No. NRC-04-78-271 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 " May 31, 1983 " is substituted for the date " June 14, 1980 ".

3. In Article III - Consideration, the sum "$ 627,808.31" is substituted for the sum "$ 234,136.01".

IN WITNESS WHEREOF, the parties have executed this document.

UNITED STATES OF AMERICA

BY: _____

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

Nuclear Regulatory Commission

ARIZONA BOARD OF REGENTS

BY: _____

Sherwood E. Carr, Treasurer and
Contracting Officer
(title)

I, James T. Wheeler (attester), certify that I am the

Assistant Vice President for Research (title) of the Contractor named

under this document; that Sherwood E. Carr (signatory)

who signed this document on behalf of said Contractor was then

Treasurer and Contracting 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.

_____

James T. Wheeler
Assistant Vice President for Research
University of Arizona

(SEAL)

CONTRACTOR: ARIZONA BOARD OF REGENTS

APPENDIX A

For the Contract period June 1, 1980 through May 31, 1983

Article A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

(a) The unclassified Scope of Work under this contract entitled, "Sealing Rock Masses" is as follows:

REPORTS:

Progress reports shall be submitted quarterly. An annual topical report shall be submitted at the end of each of the three (3) periods of work. A final report shall be submitted upon completion of the contract performance.

June 1, 1980 through May 31, 1981:

1) Laboratory Work

a) Develop a test facility for a variety of plugging materials (including clay and cement) under a variety of rocks and a range of load conditions. This includes building radial and polyaxial permeameters. The budget includes the drilling subcontract for the Subsurface Mass and Energy Transport project and for this project.

b) Use the facility to ascertain sealing performance under ideal conditions (laboratory simulated field conditions) and develop a data bank. The primary tests to be performed are rock permeability, sealant permeability, seal leakage (along the rock-seal interface) long-term seal durability, and seismic response.

2) Field Work

The materials judged best will be used for plugging holes drilled at the field-test facility in cooperation with Simpson, Neuman and Thompson in their research on ground water in fractured crystalline rocks. The performance will be tested by comparing tracer tests and fluid injection tests before and after plugging.

3) Analytical Studies

Rock creep over time will be calculated by two dimensional elastic analysis.

4) The possibility of using facilities at the Nevada Test Site for the studies in other rock typed, will be examined.

June 1, 1981 through May 31, 1982:

Research work to be performed from June 1, 1980 to May 31, 1981 will consist primarily of:

1. Field studies, including detailed comparisons between laboratory and field performance.

2. Laboratory studies (simulated field conditions) to broaden the experimental data basis.

3. Data analysis.

The main emphasis of the work during the year will be on a systematic field testing program. It is expected that the experimental work performed during the previous year will provide a solid factual basis for the final selection of sealing technology, field emplacement techniques, and degree of sealing that can be achieved under "ideal" laboratory conditions. The results obtained during the previous year will include specific data on the permeability of the rock at the location of some of the boreholes to be sealed and tested during this year. These data are essential for the subsequent plugging performance assessment.

The experimental field work will consist of drilling (coring) additional holes in selected rock types, sealing (plugging) with clay and cementitious products, and performance evaluation with pressurized injection and tracer tests. As part of the proposed field work several holes will be plugged and tested for long-term performance. Some of these tests will consist of continued steady pressurization over several months, others of intermittent short-term testing at regular intervals of several months.

Supporting laboratory work for this principal field sequence will include permeability and sealing tests on the cores recovered. This will provide the necessary reference basis for comparing the actual field performance, as it is when affected by at-depth installation procedures, with laboratory performance.

In addition to laboratory tests in direct support of the field work, it is necessary to continue laboratory studies of plugging performance that cannot be done in the field. This includes most importantly the changes in stressfields to which the rock mass can be subjected over long periods of time. Such changes will be simulated in the testing facilities developed during the previous year.

June 1, 1982 through May 31, 1983:

The main emphasis of the proposed research during this year will be on laboratory testing, with some supplementary field work.

The proposed laboratory work will consist largely of a direct continuation of work initiated previously. This will include long-term tests, i.e., direct creep loading and/or internal pressurization of plugged cores in the triaxial frames equipped for long-term testing.

The main emphasis of this last year lab work will be on extending the experimental data basis for various rock types and plugs. This will include testing in both triaxial and polyaxial conditions. At this stage of the project, the experimental work of both types will have been reduced to routine operations. It will therefore be possible to obtain an extensive data basis in a time and cost efficient fashion, by systematic studies of the performance of a variety of sealing products in a variety of rock cores.

Field work will consist of two types: continuation of previously initiated long-term tests in already plugged holes, and performance testing of new installations suggested by the results from previous field measurements or lab measurements performed as part of this contract, or by results or recommendations based on research performed at other institutions.

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

Jaak J. K. Daemen: June 1, 1980 through May 31, 1982: 20% of his time during each of the academic years and 100% of his time during each of the summers. June 1, 1982 through May 31, 1983: 10% of his time during the academic year and 50% of his time during the 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 $ 270,902.60

(2) Equipment to be purchased or fabricated by the Contractor $ 153,411.00

June 1, 1980 - May 31, 1981:

In Excess of $1,000.00

Ruska Gas and Liquid Permeameter

Universal Poro meter

Precision High-Pressure low-flow pump

Manual Grouting pump (low-pressure, low-volume)

Large-diameter self-feeding diamond saw

Radial permeameters

Polyaxial permeameters (3)

Computer terminal

pH meter

Triaxial Vessel with modified piston

Creep loading frames (3) and long-term pressure maintenance and control systems

Universal Flat Load Cells(3)

Electronic Balance

Oven with temperature-humidity controls

Multi-channel data recorder

Enerpac handpumps (2)

Mass flow meter meter with batch control

Diamond core drill bits

Accessories and auxiliary equipment

June 1, 1981 - May 31, 1982:

In Excess of $1,000.00

- 6" core barrel
- hole caliper and inclinometer
- accessories for borehole preparation and inspection
- integrated multiple-packer isolation unit with down-hole pressure-temperature-flow recorder
- tracer detector and monitor
- strain monitor and servo-control system
- accessories for laboratory equipment

June 1, 1982 - May 31, 1983:

In Excess of $1,000.00

- multiple-packer unit with built-in tracer detector, monitor and pressure-flow recorder
- lab tracer detector
- acessories for field equipment

(3) Travel

(i) Domestic $ 39,000.00

(ii) Foreign $ - 0 -

(4) Other direct costs including staff benefits

(5) Indirect costs based on a predetermined rate of 43 percent applicable to direct costs excluding equipment

(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 ESTIMATED NRC SUPPORT COST

The total estimated cost of items under A-II(a) above for the contract period stated in this Appendix A is $1,214,122.30; 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 $1,214,122.30.

The estimated NRC Support Cost is funded as follows:

(a)	Estimated unexpended balance from prior period(s)	$ 85,000.00
(b)	New funds for the current period	$ 300,000.00
(c)	Additional funds to be provided in FY-80, subject to their availability	$ 93,672.30
(d)	New funds to be provided in FY-81, subject to their availability	$ 555,970.00
(e)	New funds to be provided in FY-82, subject to their availability	$ 264,480.00

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